E ENGINEERING CONSTRUCTION WEEKLY

RAW HILL PUBLISHING COMPANY, INC. · TWENTY-FIVE CENTS, FIVE DOLLARS PER YEAR

OCT 11 1937

Engineering NEWS-RECORD

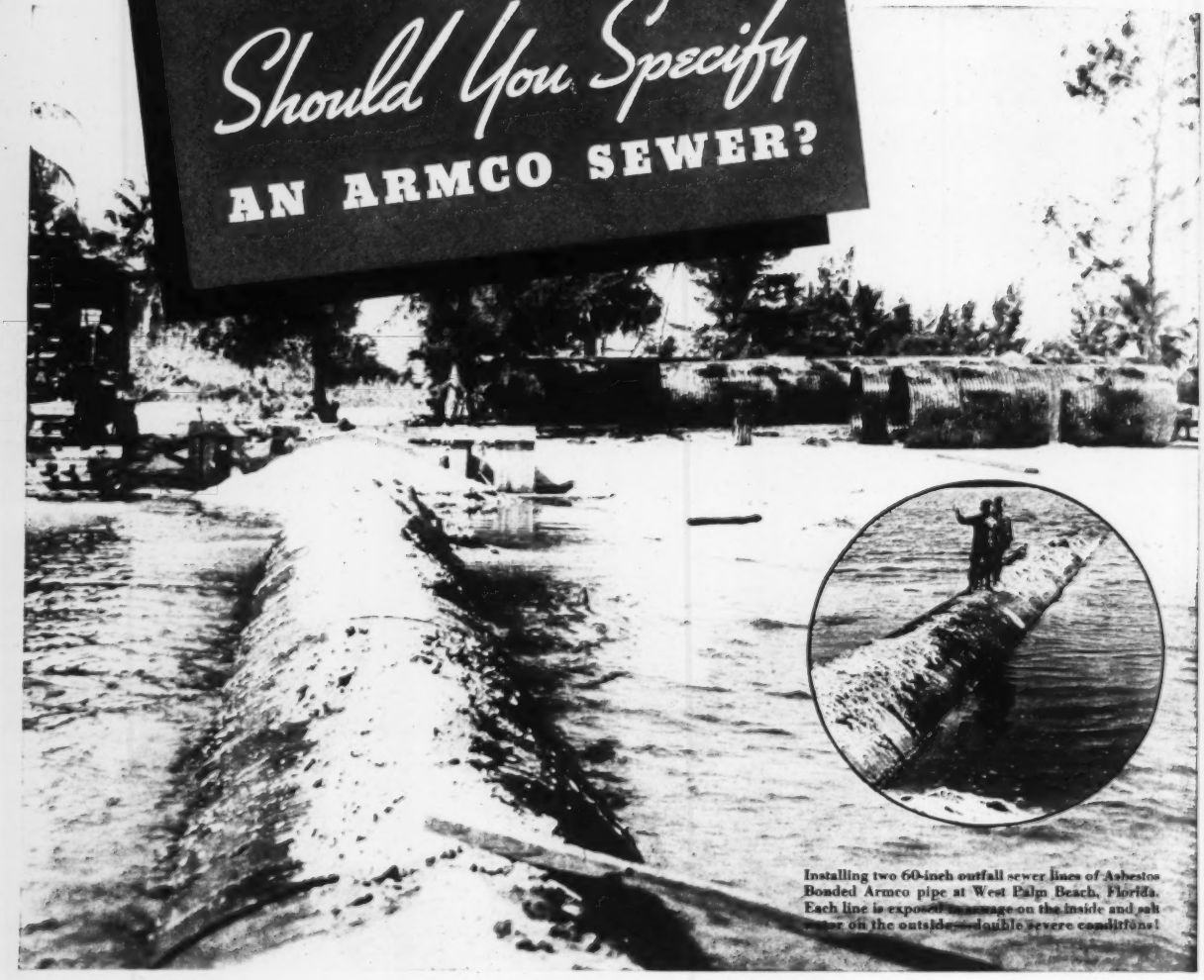
October 7, 1937

BRIDGES · IRRIGATION · FLOOD CONTROL · FOUNDATIONS · DAMS ·

IGHWAYS · WATERWORKS · STR S ·

UNIVERSITY OF MICHIGAN
GENERAL LIBRARY
ANN ARBOR MICH 2-C

WHY *Should You Specify* AN ARMCO SEWER?



Installing two 60-inch outfall sewer lines of Asbestos Bonded Armco pipe at West Palm Beach, Florida. Each line is exposed to sewage on the inside and salt water on the outside—double severe conditions!

2 Good Reasons

WHEN YOU DESIGN a sewer system of Armco corrugated pipe say good-bye to costly structural failures. Even under the most severe loading and foundation conditions, you can depend on this sturdy, flexible pipe to serve as a line *during its full material life.* This asurance comes from 41 years of successful experience with thousands of installations.

Now to the superior *structural* features of corrugated metal pipe Armco has added a high degree of *material* permanence. Many ARMCO Ingot Iron sewers laid nearly *30 years* ago are sound and strong today. Putting a thick bituminous pavement in the bottom has added at least another *12 years* to the life of Armco pipe. And now . . . with a complete bituminous coating permanently "bonded" to the galvanized metal, your durability problem is solved!

Why not call in an Armco drainage engineer and let him explain the advantages of this improved sewer pipe — in terms of your 1937 requirements? Armco Culvert Mfrs. Association, 703 Curtis Street, Middletown, Ohio.

ARMCO

ASBESTOS BONDED • ARMCO PAVED INVERT PIPE

Reason Seeks a Leader

AN INDUSTRIALIST sat through a business convention and listened to the speakers sound off "in defense of business." They flayed the national administration and organized labor. They denounced the interference of government in economic affairs.

Afterward, privately, the industrialist commented on the occasion. "I doubt," he said, "whether most of those present, including the speakers, really are as extreme as those speeches would imply. In our hearts we all know that every question has three sides—my side, your side and the right side. But when we are in a fight we dare not concede any side but our own.

"But sometimes I wonder whether our fighting phrases really reflect our true convictions. I have a hunch that most of the men responsible for the management of industry are more reasonable and moderate than their expressions would indicate. I know that a lot of us would gladly help to correct the evils of business if we were not so afraid of opening the door to even worse abuses. It's too bad but that's the way it seems to be."

A LABOR LEADER held forth before his followers "in defense of labor." He flayed the leaders of organized business, the owners and managers of industry. He was intolerant and uncompromising.

Afterward, privately, he commented on the occasion. "Of course," he said, "I know that all the employers are not as black as I paint 'em. Many of them are mighty fair men, trying to do the right thing by their people. I know, too, that some of the laborskates are pretty unscrupulous racketeers. But when you are in a fight you can't afford to admit that there's anything right about the other side or wrong with your own.

"Then, too," he continued, "I'm on a hot spot. Some of the things I say may be extreme but I've got to say them or else I'll lose my own crowd to those same racketeers. I know that a lot of employers can't do any more than they are doing, but I don't dare admit it. It's too bad but that's the way it is."

Those two statements embody the tragedy of industrial relations. Reason, conviction, moderation and frankness must be sacrificed to the needs of partisan tactics.

So long as human nature remains human, progress in human relations must be a compromise between reason and feelings. The fighting leader on every side of every question knows this: he knows, too, that an appeal to the feelings is more effective with most men than an appeal to reason. It is easier to feel than to think, easier to resent our present wrongs than to see ahead the graver ills our resentment may breed.

But even so, must we abandon all hope for a leadership that will take up the cudgels for reason and make a fight for moderation and the reconciliation of extremes? Can leadership in a democracy survive only by pandering to one extreme or the other? Are not most responsible men moderates at heart? Are they justified in feeling that they dare confess their moderation only in private? Would they not rally to a leadership of reason?

TO THE LAST QUESTION the professional politician answers no. If he is right, democracy truly is in a bad way. But it is quite possible that he may be mistaken. Today, in the ranks of both labor and employers, many are yearning for a leadership that will reject the extreme views that have been bred of conflict and work for a rehabilitation of the economic structure with an eye to the advantage of all, rather than of this class or that.

But no mere politician, however adroit, can provide such leadership. A politician is one who knows how to win popular support. There he stops. But a statesman is one who knows how to win popular support for policies that conserve the general welfare. We have plenty of politicians; we need a statesman—one having the fairness, the courage and the skill to allay mistrust and command the confidence of the moderates in every group.

In such a leadership any President of the United States should find a mission worthy of the highest political skill and in keeping with the finest traditions of his high office.

Willard Chevalier

ENGINEERING NEWS-RECORD

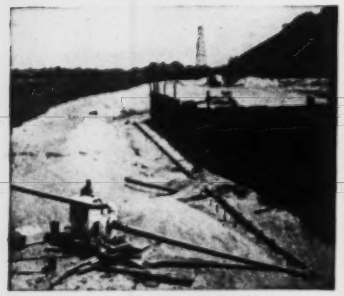
Published every Thursday. Vol. 119, No. 15. Price 25c per copy. Subscription, domestic, Canada, Mexico, Central and South American countries, $5 per year. All other countries, $9 a year or 36 shillings. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C.

Copyright 1937 by McGRAW-HILL PUBLISHING COMPANY, Inc.

Editorial and Executive Offices: 330 West 42d St., New York. Publication Office: 99-129 N. Broadway, Albany, N. Y. Branch Offices: 520 N. Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

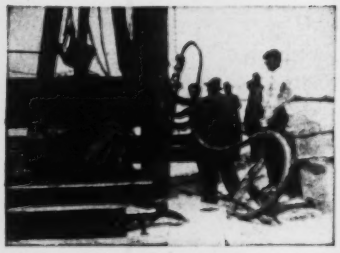
JAMES H. McGRAW, JR., President HOWARD EHRLICH, Exec. Vice President JAMES H. McGRAW, Honorary Chairman
WILLARD CHEVALIER, Vice President B. R. PUTNAM, Treasurer D. C. McGRAW, Secretary A. W. MORRISON, Circulation Manager

JAEGER Offers to Contractors . . .

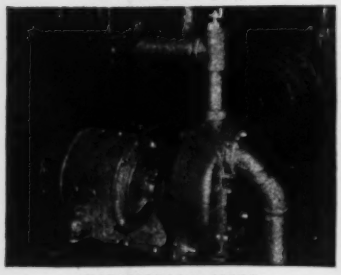


WELL POINT SYSTEMS

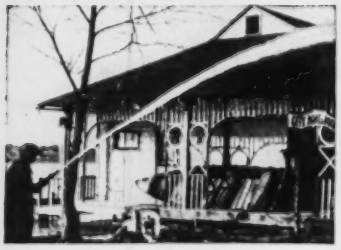
DRAINAGE JOBS



JETTING WORK



INDUSTRIAL USES



FIRE PROTECTION

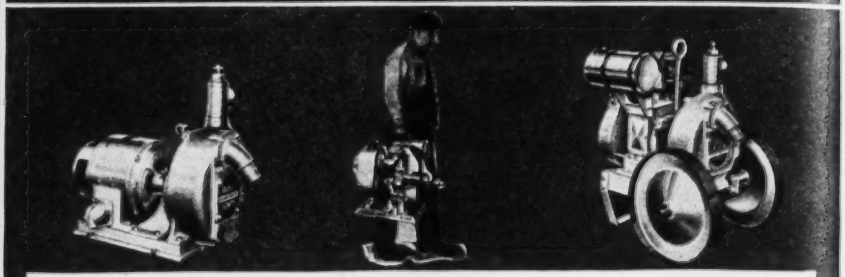
Send for Catalog and Latest Prices!

A COMPLETE LINE OF PUMPS

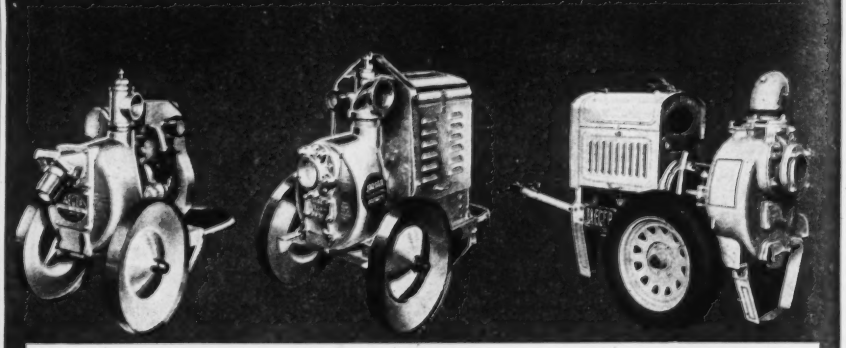
SELF-PRIMING CENTRIFUGALS

WELL POINT SYSTEMS

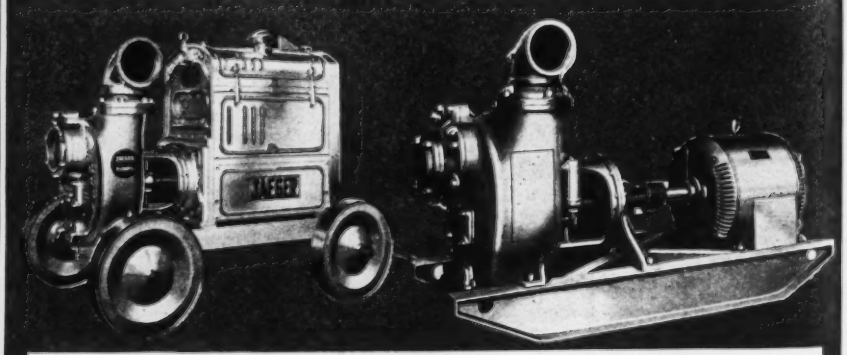
JETTING PUMPS – TRIPLEX PUMPS – DIAPHRAGMS



SMALL ELECTRICS 2"—3"—4" SIZES | BANTAM-WEIGHT 7000 G.P.H. | 2" HEAVY DUTY 10,000 G.P.H.



3" HEAVY DUTY 20,000 G.P.H. | 4" HEAVY DUTY 40,000 G.P.H. | LIGHT AND HEAVY 6" PUMPS 75,000—90,000 G.P.H.



8" HEAVY DUTY 125,000 G.P.H. | 10" HEAVY DUTY 175,000—200,000 G.P.H.

JETTING PUMPS | DIAPHRAGM PUMPS | ROAD PUMPS

THE JAEGER MACHINE CO., 200 Dublin Ave., Columbus, O.

· ENGINEERING NEWS-RECORD ·

McGRAW-HILL PUBLISHING COMPANY, INC.

WILLARD CHEVALIER, *Vice-President*

Editorial and Executive Offices: 330 West 42nd Street, New York . Publication Office: 99-129 North Broadway, Albany, N. Y.

F. E. SCHMITT, *Editor* ALBERT E. PAXTON, *Manager*

Copyright 1937

VOL. 119 *OCTOBER 7, 1937* No. 15

THIS WEEK AND NEXT

AS LONG AS the 1936 New England flood remains the record, the city of Fitchburg, Mass., will fear no high waters, for the North Nashua River is being given an adequate floodway through the channel cleaning and enlargement, rebuilding of bridges and wall and riprap bank protection described in this issue.

Inconsistencies in the various weir formula exponents may be explained by experiments at Union College, Schenectady, which classify flow into three types according to crest length.

After a severe spring breakup in 1936, Oregon highway department men tried substituting machine spreading for the older practice of hand raking asphalt resurfacing. W. W. Stiffler tells how this experiment proved successful.

Actual strain measurements on reinforcing steel in concrete pipes are described on page 597. The authors believe these are the first to be made.

Ten freight cars piled up on a 150-ft. riveted truss bridge near Pittsburgh. Four panel members were snapped and half of the other members were damaged, but the bridge held.

Waterworks men meet at Poland Springs. An editor returns with a notebook full of terse comment on the happenings of the meeting.

It seems that specifications for tolerances in deep cylindrical pier foundation construction vary considerably. Robert H. Chambers, a recognized authority on the subject, recommends unification measures.

UNPRECEDENTED submarine exploration work was carried on by the Army Engineers to determine the foundation conditions for the great rockfill dams of the ill-fated Quoddy tidal power project. These operations will be described next week.

		PAGE
The Week's Events		577, 611
Reader Comment		585
Editorials		586
Pictures in the News		588
Flood Control at Fitchburg *(Channel excavation, Crib and masonry retaining walls)*		589
Classification of Weir Discharge *(Fluid mechanics, Flow phenomena)*	ROBERT ABBETT	594
Machine-Spread Asphalt *(Bituminous roads, Construction machinery)*	W. W. STIFFLER	595
Steel Stresses in Concrete Pipe *(Strain measurement)*	D. B. GUMENSKY and N. D. WHITMAN	597
Bridge Resists Train Wreck		600
Much Deferred Construction		601
New England Waterworks Meeting *(Corrosion control, Gravel-packed wells, Water treatment)*		602
Tolerances in Tilted Piers *(Building foundations, Specifications, Reinforcing)*	ROBERT H. CHAMBERS	606
Air Conditioning Demands on Facilities *(Water supply, Sewerage)*		608
From Field and Office		609
Construction Labor and Material Prices		614
New Aids to the Constructor	*Adv.page*	35
Construction Reports	*Adv.page*	51

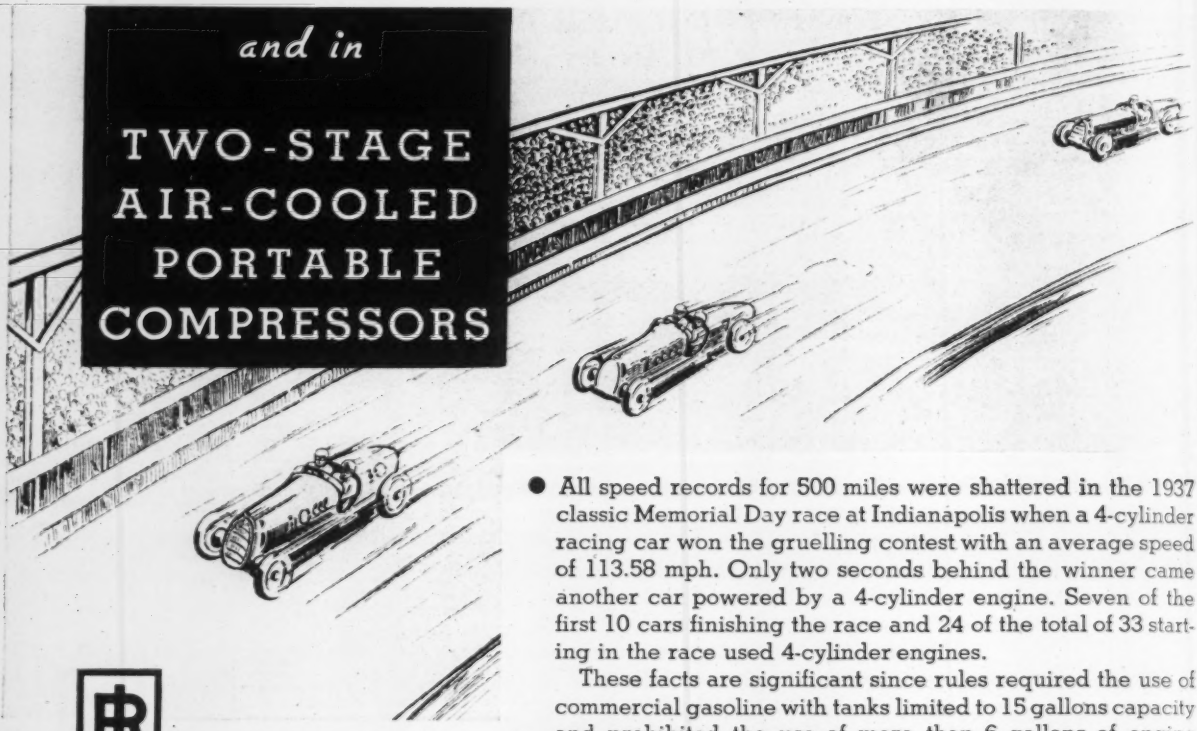
COVER PICTURE—Flood-control operations in Fitchburg, Mass., showing channel enlargement work and one of the old bridges that is being removed to obtain an adequate channel.

Number of copies of this issue printed: 29,077

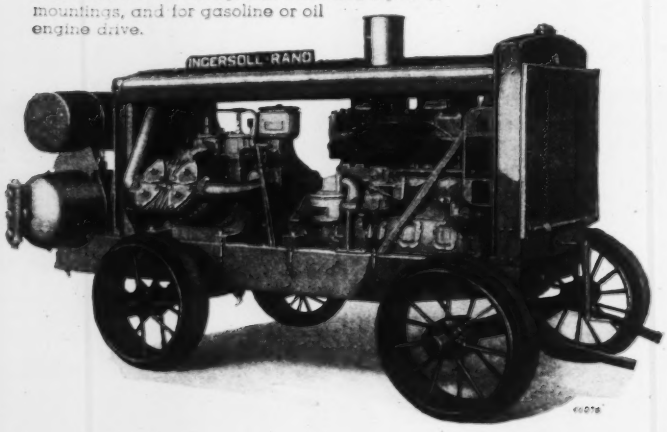
4-Cylinder Engines at Indianapolis

and in

TWO-STAGE AIR-COOLED PORTABLE COMPRESSORS



I-R Two-Stage Air-Cooled Portable Compressors are available in sizes for 60, 105, 160, 210 and 315 cu. ft. per min., actual capacity at 100 lbs. pressure with all the recognized standard styles of mountings, and for gasoline or oil engine drive.



● All speed records for 500 miles were shattered in the 1937 classic Memorial Day race at Indianapolis when a 4-cylinder racing car won the gruelling contest with an average speed of 113.58 mph. Only two seconds behind the winner came another car powered by a 4-cylinder engine. Seven of the first 10 cars finishing the race and 24 of the total of 33 starting in the race used 4-cylinder engines.

These facts are significant since rules required the use of commercial gasoline with tanks limited to 15 gallons capacity and prohibited the use of more than 6 gallons of engine lubricating oil.

Because of this characteristic economy, endurance and efficiency only 4-cylinder engines are used in I-R Two-Stage, Air-Cooled Portable Compressors.

Our twenty years of experience with these 4-cycle, heavy-duty type engines on portable compressor service has resulted in 20% to 30% more power, stronger materials, improved cooling, greater efficiency, smoother performance and higher sustained output.

The results of the Indianapolis race verify our selection of 4-cylinder engines for overall economy on heavy-duty service. Many thousands of our portable compressors are giving dependable and economical service, in all parts of the world on all kinds of work.

The I-R line includes 1000 sizes and types of air compressors; over 500 different rock drills and pneumatic tools; hoists; pumps and engines for mines, quarries and contractors. Let us help you with your problems.

542-2

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Knoxville

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

Kansas City, Los Angeles, Newark, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, Tulsa, Washington

· ENGINEERING NEWS-RECORD ·
OCTOBER 7, 1937

THE WEEK'S EVENTS

WHAT BECAME OF THE SLUM

A 12-BLOCK AREA, once one of the worst slums in New York City, now looks like this, as Williamsburg Houses, $15,460,000 PWA low-cost housing project begins to take tenants. Six of the twenty buildings in the project were opened for occupancy Sept. 30. When the project is completed, apartments will be provided for 1,622 families at an average rental of $4.45 per week for a two-room unit and $6.61 for a five-room unit.

The New York City Housing Authority, on October 4, took over management of the project under a one-year lease with a total annual rental of $193,000. On this basis the project will repay to the government 55 per cent of its total cost over a period of 60 years.

To Reorganize PWA Offices

State offices will be closed and administration put on a regional basis

Reorganization of the field staff of the Public Works Administration to effect savings in overhead, rent, supplies, equipment and personnel will take place Nov. 1, according to an announcement by Administrator Ickes. On that date all existing state offices will be closed and the supervisory duties which they now handle will be turned over to a much smaller number of regional offices to be established in natural geographic sub-divisions.

In carrying out the new plan the entire country has been divided into seven division, in each of which PWA supervision will be centralized in a central office. The seven offices will be located at New York City, Chicago, Atlanta, Omaha, Fort Worth, San Francisco and Portland, Ore. Staffs for these regional offices will be selected from the present PWA personnel, but despite this there must be many separations from the service.

Including both field and headquarters employees, PWA administrative personnel has been decreased to 6,822 persons from a peak of 10,938 in April, 1936. The agency now has under construction, contract, or allotment 2,980 projects with a total aggregate cost of $1,986,592,702 which must be completed by July 1, 1939, when PWA legally expires. It has completed and put in service 23,491 public works projects valued at $2,303,254,629.

The effect of the PWA cessation of further allotments upon large projects was also discussed by Administrator Ickes. While it is true," he said, that PWA still has unallocated funds forming a reserve to finance lengthy projects and to take care of rising construction costs, it will probably be necessary in some cases for Congress to provide additional appropriations as part of the normal public works budget. For example, the total cost of the Santee-Cooper development in South Carolina is estimated at $37,500,000, whereas PWA has so far allotted only $6,000,000.

State Anti-Pollution Act Upheld by Court

The constitutionality of an Indiana law passed in 1935 giving the state commerce department power to order cities and industries to stop polluting streams in the state has been upheld by the circuit court in Blackford county.

The case arose through an order made by the department that Hartford City, Ind., stop polluting Lick Creek with sewage, setting Dec. 31, 1938 as the deadline.

The city appealed the ruling to the circuit court, which affirmed the order.

Mayor Gardiner of Hartford City stated that the city would not appeal the ruling but would have a sewage disposal plant in operation before the deadline.

The Hartford City case was the first court test of the law. Several other orders have been made and are being compiled with.

MAJOR NEWS

	Page
Reorganize PWA	577
Highway Officials Meet	578
New Manager for Gate Bridge	580
Record Rain in New Orleans	581
Power Plant Valuation	581
Five Killed in Detroit Sewer	581
Beach Preservation Meeting	583
PWA Sues Defaulters	583
Big Power Plant	584

Highway Officials Break Records

Safety work and highway financing stressed at state highway officials meeting

All previous convention attendance records of the American Association of State Highway Officials went by the board in Boston Sept. 27-30 when delegates from 45 states put in four days of intensive work on the pressing problems of the modern roadway and profited materially from a technical and social program of unusual interest. The total registration reached 858, including many ladies who shared the general sessions and entertainment schedule provided. New England hospitality was at its best, and the weather mainly favorable to the outdoor entertainment of the visitors. The numerous group meetings and committee sessions yielded valuable discussion, which will be reviewed in our next issue.

Gov. C. F. Hurley of Massachusetts welcomed the delegates at the opening session on Sept. 27, stressing the Bay State's 1,900 miles of state highways as an invitation to use; commending the cooperation of the Federal Bureau of Public Roads; emphasizing the recovery from last year's flood damage; and urging consideration of the 4-months' safety drive against highway accidents starting in Massachusetts Oct. 4.

President T. H. Cutler warned his hearers to place as much of their highway project funds under contract as possible before seeking appropriations from the next Congress. If this is not done, opponents of such outlays will make capital of it at the next session and the important work of anticipating traffic necessities will be hampered. In the past seven years American automobile production has increased 40 per cent and individual car mileage doubled, or an 80 per cent rise against a 40 per cent gain in road mileage. Accidents present a major problem. President Paul G. Hoffman of the Automotive Safety Foundation estimates that $40,000,000 a year would insure a successful safety program for the country; a small proportion of the $820,000,000 property damage annually resulting from motor vehicle accidents. Mr. Cutler stated that plans are maturing for providing a contact man to travel the country in the interests of safety work, legislative problems and coordinated problems of highway practice. Among present needs are more uniform laws and minimum standards of factual analysis, closer study of inspectional services and patrol organizations, more extended research and cooperation of agencies concerned with highways.

The committee on resolutions reported in favor of expressing the association's appreciation to Congress for financial aid to state highway construction; of urging the continuance of federal funds for secondary highway; recommending that state highway departments establish highway safety

(Continued on page 583)

BOULDER DAM LOWERED THIS BRIDGE

AN INCIDENTAL but important effect of the flood control and reclamation program on the Colorado River is that it makes possible construction of low, trestle-type bridges. The Parker bridge opened Sept. 25 is the first bridge across the lower Colorado to be constructed since Boulder Dam tamed the river. The bridge is a trestle-type structure consisting of ten 63-ft. spans and was built at a cost of $134,000. It can be seen how low the bridge is placed in comparison with the railroad bridge in the background.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY *ENGINEERING NEWS-RECORD*, IN SEPTEMBER, 1937

Engineering News-Record *reports projects of the following minimum cost: Water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States September 1937	United States Nine Months 1937	United States Nine Months 1936	Canada
Public Works										
Waterworks	278	2,097	272	935	504	3,073	7,159	56,928	78,986	120
Sewerage	41	2,288	173	6,971	1,105	698	11,276	76,274	95,068	121
Bridges	580	4,035	3,688	1,188	2,323	2,219	14,033	95,838	131,881	288
Earthwork and waterways	127	511	2,426	3,033	3,839	640	10,576	82,243	141,319	785
Streets and roads	3,974	10,107	8,864	9,215	11,636	2,731	46,527	320,276	368,378	4,020
Buildings, public	2,314	9,712	1,639	2,620	7,812	1,046	25,143	244,192	357,612	861
Unclassified, public	353	4,343	740	912	989	3,894	11,231	115,833	74,516	744
Total public	7,667	33,093	17,802	24,874	28,208	14,301	125,945	991,584	1,247,760	7,443
Federal government (included in above classifications)	363	4,493	3,527	3,046	10,986	4,359	26,774	161,106	253,888	.....
Private										
Bridges, private	70	633	.....	25	.....	.....	708	6,549	9,484	.....
Buildings, industrial	1,401	3,523	1,260	15,310	10,627	2,065	34,186	406,580	195,939	1,615
Buildings, commercial	940	29,621	4,779	1,240	1,110	2,893	40,583	351,172	197,285	.....
Unclassified, private	20	1,744	782	3,329	1,839	1,375	9,089	130,123	87,191	114
Total private	2,411	35,521	6,821	19,904	13,576	6,333	84,566	894,424	489,899	1,729
Total Engineering Construction										
September, 1937 (5 weeks)	10,078	68,614	24,623	44,778	41,784	20,634	20,511	.....	.....	9,172
August, 1937 (4 weeks)	9,352	51,649	21,966	36,451	26,739	24,811	170,068	.....	.....	17,369
September, 1936 (4 weeks)	10,844	86,088	26,778	24,185	29,621	19,856	197,372	.....	.....	7,131
Nine months, 1937	90,057	829,964	186,750	314,534	273,991	190,712	.....	1,886,008	.....	102,768
Nine months, 1936	112,271	565,719	223,576	246,139	329,009	210,945	.....	.....	1,737,659	71,087

THE CURRENT TREND

This week's news of contract volume and construction cost factors

THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Oct. 8 1936	Sept. 30 1937	Oct. 7 1937
Federal	$4,920	$7,591	$4,048
State & Municipal	24,844	15,461	19,393
Total public	$29,764	$23,052	$23,441
Total private	18,570	19,442	25,389
TOTALS	$48,334	$42,494	$48,830

Cumulative
1937 (40 weeks) $1,934,838
1936 (41 weeks) $1,843,063

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1936 41 Wks.	1937 40 Wks.
NON-FEDERAL	$712,124	$1,287,023
State & mun. bonds	392,033	410,511
Corporate securities	204,009	468,447
PWA loans, grants	91,084	178,126
RFC loans	24,998	29,939
Fed. aid for highways	.....	200,000
FEDERAL	$691,237	$746,223
TOTAL CAPITAL	$1,403,361	$2,033,246

ENR INDEX NUMBERS

COST			VOLUME		
Base = 100	1913	1926		1913	1926
Oct., 1937	244.95	117.55	Sept., 1937	148	65
Sept., 1937	243.95	117.27	Aug., 1937	150	66
Oct., 1936	211.50	101.67	Sept., 1936	200	88
1936 (Av.)	206.46	99.24	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50

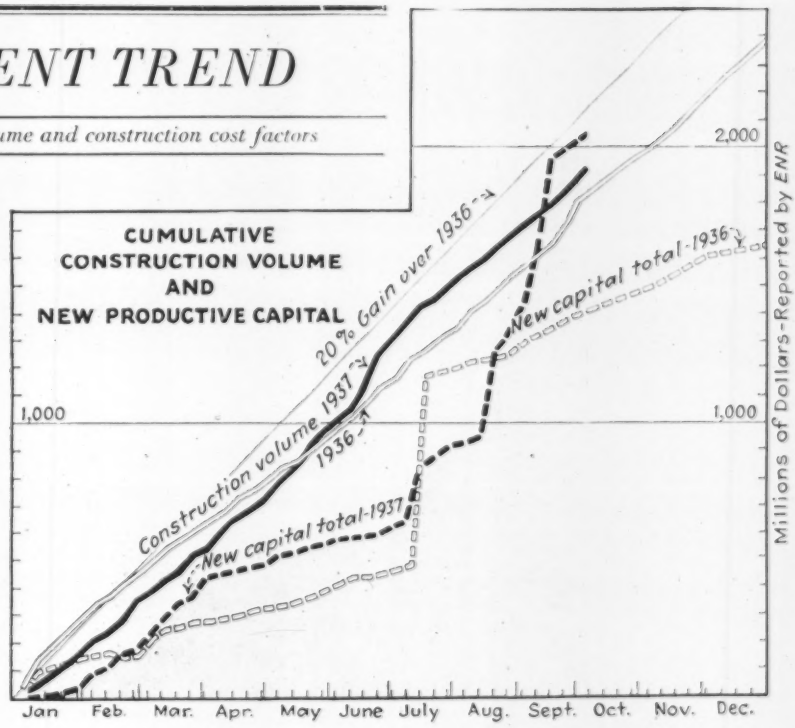
Business Briefs

EMPLOYMENT in the production of six major construction materials for August, as measured by the PWA Projects Division index, is 63.1 compared with 63.9 for July and 59.0 for August, 1936.

AUTOMOBILE production for this year is expected to pass 5,000,000 units, an all time high. The previous high mark was in 1929 with 4,794,898 units.

TERRA COTTA orders for the 8 months total 11,880 short tons compared with 11,584 a year ago. Low prices in the spring held down the 8-months' value to $1,273,037 compared with $1,369,668 in 1936.

REAL ESTATE PRICES are 10 to 15 per cent higher than they were a year ago, according to survey made by the National Association of Real Estate Boards. The survey covers 256 cities. Another result of the survey: There is no over-supply of single-family dwellings, but in 82 per cent of all cities of over 500,000 population there is an oversupply of business buildings.



THE MONTH'S SCOREBOARD

CONSTRUCTION VOLUME

Construction Volume (Thousands omitted)	September 1936	1937	% Change	9 months 1936	1937	% Change
Total	$167,372	$210,511	+15	$1,737,659	$1,886,008	+8
Private	84,432	81,566	−20	889,899	894,424	+83
Public	112,940	125,945	+11	1,247,760	991,584	−20
Federal	26,289	26,774	−18	253,888	161,106	−36

NEW PRODUCTIVE CAPITAL

Total	$126,599	$688,922	+335	$1,381,636	$2,014,905	+45
Private Investment	81,093	92,529	−9	578,874	860,617	+50
Federal (non-fed. wk.)	45,506	111,227	+96	111,525	408,065	+266
Federal (fed. wk.)	.....	485,166	.....	691,237	746,223	+8

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	Oct. 1936	1937	% Change	Change Sept. to Oct. 1936 Sept.	Oct.	%	1937 Sept.	Oct.	%
ENR Construction Cost Index 1913 = 100	211.50	244.55	+16	208.10	211.50	+2	243.95	244.55	+0.4

ENR 20-CITIES AVERAGE

Common Labor	$.583	$.676	+16	$.569	$.583	+2	$.673	$.676	+0.6
Skilled Labor	1.176	1.378	+17	1.159	1.176	+1	1.369	1.378	+0.7
Bricklayers	1.228	1.467	+19	1.206	1.228	+2	1.459	1.467	+0.5
Struct. Ironworkers	1.223	1.425	+16	1.218	1.223	+0.4	1.413	1.425	+0.8
Carpenters	1.077	1.242	+15	1.054	1.077	+2	1.235	1.242	+0.6
Cement, per bbl	$2.59	$2.53	−2	$2.58	$2.59	+0.4	$2.53	$2.53	0
Reinforcing Steel, new billet	2.67	2.91	+9	2.66	2.67	+0.2	2.91	2.91	0
Struct. Steel, Pittsburgh	1.90	2.25	+19	1.90	1.90	0	2.25	2.25	0
Sand, per ton	1.20	1.22	+2	1.20	1.20	0	1.16	1.22	+5
Lumber, 2x4 Fir, per M.	33.23	37.02	+11	33.59	33.23	−1	37.23	37.02	−0.6
Lumber, 2x4 Pine, per M.	30.79	32.60	+6	30.79	30.79	0	32.93	32.60	−0.5
Brick, Common, per M.	13.86	14.23	+3	13.86	13.86	0	14.33	14.23	−0.7
Ready-mixed concrete	7.14	7.32	+3	7.14	7.14	0	7.38	7.42	+0.5
Struct. Clay Tile, 3x12x12	72.65	72.85	+0.3	72.65	72.65	0	72.85	72.85	0
Paving Asphalt, cars, ton	16.90	17.15	+1.4	16.87	16.90	+0.2	17.15	17.15	0

MATERIAL SHIPMENTS

	September 1936	1937	% Change	August 1937	% Change July-Aug.
Lumber (% 1929 wk. av. Shipments) N.L.M.A.	68	65	−4	69	−6
Steel A.I.S.I. (% Operating Capacity)	72.6	75.6	+4	84.2	−10

	August 1936	1937	% Change	Eight months 1936	1937	% Change
Cement (Bur. of Mines) Thous. Bbl.	12,599	12,291	−3	74,670	77,066	+8
Fabricated Struct. Steel Shipments* A.I.S.C., Tons	142,709	158,228	+11	980,077	1,082,844	+10

* Subject to revision.

BUILDING PERMITS

	August 1936	1937	% Change	Eight months 1936	1937	% Change
Dun and Bradstreets, $(000 omitted)	83,119	87,545	+5	642,035	764,718	+19

THE OUTERLINK IS THE LAST LINK

WHEN THESE SPANS dropped Oct. 5 as the Outerlink Bridge was dedicated, they closed the last gap in one of the longest uninterrupted metropolitan drives in the world. The 30-mile Outer Drive system in Chicago achieves a nearly non-stop route along the shores of Lake Michigan from the far south side of the city to the far north shore, by-passing the tangled traffic of the loop area.

The Outerlink Bridge across the Chicago River, last link in the express highway project, is of double-leaf bascule construction with 220 ft. clearance between tiers. The bridge carries eight traffic lanes and two 14-ft. sidewalks.

The $6,574,000 bridge was constructed with the aid of a PWA grant of $1,972,000.

Unemployment Census Starts in November

Plans for the census of the unemployed and partially employed for which Congress appropriated $5,000,000 at the last session were announced Sept. 27 by John E. Biggers, administrator of the census. Plans call for a voluntary registration of the unemployed through the facilities of the post office, to be checked by a house-to-house census in certain test areas.

Registration blanks containing not more than 11 questions will be distributed to about 31,000,000 families by the post office department Nov. 16 and 17. These are to be filled out and returned by Nov. 20. During the six weeks following, a house-to-house census will be carried on in typical cities, towns and counties, and the results will be compared with registrations in those areas to work out the degree of accuracy of the voluntary registrations. Checks may also be made by WPA and the United States Employment Service and by various private agencies.

Tabulation of the returns will be made by the Bureau of the Census.

The voluntary registration will be proceeded by an intensive program of propaganda to encourage cooperation in the plan.

• • •

Sverdrup to Assist Study Of Slumped Dam

L. J. Sverdrup, consulting engineer, St. Louis, a member of the firm of Sverdrup & Parcel, has been engaged by the Wyandotte County Commissioners to assist in the study of the foundations of Marshall Creek Dam near Kansas City, Kan., that failed on Sept. 20. The board appointed about ten days ago (*ENR*, Sept. 30, p. 535) consists of H. L. Reppart, R. V. Smrha, G. A. Hathaway, and R. E. McDonnell.

Drill rigs have been set up at the dam and others are being brought in. It is expected that the underground exploration work will require about a month.

New Manager Appointed For Gate Bridge

The directors of the Golden Gate Bridge and Highway District have appointed William H. Harrelson general manager of the district. At the same meeting, the directors appointed Russell G. Cone, resident engineer during the construction of the bridge, as district engineer.

There was some question in the minds of the directors as to whether they or Mr. Harrelson should make the Cone appointment.

Mr. Harrelson succeeds to the post made vacant by the resignation some time ago of James Reed. Mr. Cone will fill the place of chief engineer Joseph B. Strauss, who resigned as of Oct. 1.

The directors voted appreciation to Mr. Strauss of his services in the construction of the bridge, retaining him as chief consulting engineer for the bridge at a salary of $1 a year, and presented him with a gold pass giving him perpetual permission to pass over the bridge.

Near Record Rainfall In New Orleans

Fourteen inches fall in 30 hrs overloading pumps and flooding streets

Rainfall amounting to 14.25 in. between 2:45 p.m., Oct. 1 and 8:00 p.m. Oct. 2 flooded large areas of the city of New Orleans. The rain was the heaviest since the 14.1 in. 24-hr. downpour on Good Friday, 1927.

The flooding of areas of the city was occasioned by the inability of the drainage system to handle the water. Much of New Orleans is below sea level, and, since the drainage canal to Lake Pontchartrain cannot handle the full drainage from the city, much of the water must be pumped up to sea level. The present rainfall considerably exceeded the amount for which the drainage system is designed.

The steady 12-hour progress in the flooding of the city is revealed in the table below. The maximum capacity of the canal and pumping facilities of the New Orleans Sewerage and Pumping Board are designed to have a capacity equivalent to a rainfall of ½ inch per hour. In the table below, the accumulated surplus, in inches of rainfall, of actual rainfall over plant capacity, is shown in the third column, "accumulated surplus."

Between 2:45 p.m. Oct. 1 and 11 p.m. of that day, rainfall amounted to 1.85 inches. After 11 p.m. rainfall began to exceed plant capacity. The cumulative total rainfall and the accumulated surplus, hour by hour, was as follows:

TIME	CUMULATIVE RAINFALL	CUMULATIVE SURPLUS
Midnight ...	2.91 inches	0.56 inches
1 a.m., Oct. 2	3.65	0.80
2 a.m.	4.20	0.85
3 a.m.	4.70	0.85
4 a.m.	5.07	0.72
5 a.m.	5.82	0.97
6 a.m.	6.41	1.06
7 a.m.	7.11	1.26
8 a.m.	8.79	2.44
9 a.m.	10.02	3.17
10 a.m.	11.86	4.51
11 a.m.	12.71	4.86
12 m.	13.15	4.80
1 p.m.	13.57	4.72

Rainfall between 1 p.m. Oct. 3 and 8 p.m. amounted to 0.67 inches, affording the drainage plant an opportunity to remove accumulated water.

Although some trouble was experienced with the plant due to the heavy load, it was not an important factor in causing the flooding.

By mid-morning of Oct. 2 all street car service was suspended in the lower area of the city. The water reached a depth of several feet in the worst affected section; basements of buildings and residences were flooded, and water entered ground floors of some business houses and theatres.

Street car service was resumed on the higher placed lines early in the afternoon, and the city was substantially cleared of water before midnight.

Although the rain continued intermittently until the afternoon of Oct. 3, reaching an all-time 48-hour record of 16.65 in., no further difficulty was experienced.

• • •

Court Upholds Commission On Power Plant Cost

Some light was thrown on the process of determining the original cost of hydroelectric power development under the provisions of the original Federal Power Act by a decision handed down Sept. 27 by the District of Columbia Court of Appeals upholding a finding of the Federal Power Commission that the Alabama Power Co. was not justified in using a price at which it bought certain land from a wholly owned subsidiary as a basis for fixing the cost of Mitchell Dam on the Coosa river in Alabama. The findings of the commission were sustained by the court on all but two points.

The company had claimed a cost of $3,500,000 for the purchase of necessary land for the project. The commission reduced this figure to $76,000. The company had formed a wholly owned subsidiary eight years before construction of the dam and had transferred to it property already acquired. The company based its valuation of the land on the price established by this transfer. The commission disregarded the transfer and used the original cost of acquisition of the land.

The court upheld the commission on this point, but directed that a determination be made of the value of certain water rights upon which the commission had refused to accept testimony.

The company had charged interest on the cost of land from the date of acquisition, in some cases 12 years before the beginning of construction, but the commission eliminated interest except for three years before construction. The court sustained the commission.

The company failed to show the actual cost of certain old surveys made long before construction, but claimed an allowance for the cost, which was disallowed by the commission. The court sustained the commission, but directed that if, on rehearings, the company could produce actual cost evidence, it should be allowed.

The commission and the company differed on the basis of computing the cost of energy used for construction purposes. On this point the company was sustained.

Five Men Killed In Detroit Sewer

Compressed air heading between two sections of sewer tunnel blows out

Five men were killed and a score injured Oct. 2 when the nearly-completed compressed-air heading on Sec. 11 of the Detroit interceptor sewer tunnel on West Jefferson Ave. blew into the completed heading of adjoining Sec. 10. The exact cause of the accident and conditions at the face at the time of the blow have not yet been determined, and may never be known, for the four workmen and one inspector on duty at the face were all killed. Cyril F. Klyne, an engineer in the employ of the Detroit department of public works, was the inspector who lost his life. Sec. 11 of the tunnel was being driven as a continuation of Sec. 12 by the shield method from a shaft at the far end of the latter section. The two sections aggregated 10,215 ft. of single heading (*ENR*, July 29, 1937, p. 188).

The face of Sec. 11 was only 7 ft. from the bulkhead at the end of Sec. 10. Working under compressed air of 9 lb. pressure, the crew was mining ahead of the shield to make the junction. It is presumed that the face was kept breasted and that excavation was being carried out under the protection of poling boards, but the failure of the bulkhead and the collapse of ground between the sections has left the junction in such a mess than the original conditions are beyond determination. The city engineer is conducting an investigation.

The ground through which the shield had been traveling was the characteristic Detroit blue clay, admitted to the tunnel through openings in the shield bulkhead. However, sand streaks had been noticed as the shield approached the junction, and a sand pocket might have been present as a contributing cause to the blow-in.

The accident marred an almost perfect safety record for the entire length of the shield section. Phenomenal progress has been made in the driving, which has averaged 60 ft. of shield advance per day, and has reached as high as 72 ft. in four 5-hr. shifts. A precast concrete block lining 16 in. thick is erected within the shield, followed closely by a 16-in. monolithic concrete lining.

The tunnel is part of the extensive interceptor sewer system being built by the city in connection with its sewage disposal program. The S. A. Healy Company of Chicago is contractor on the shield sections.

LABOR NOTES

A WIDE OPEN SPLIT between opposing groups in the Building Trades Department of the A.F. of L. appeared to offer a distinct threat to the machinery set up last year for the settlement of jurisdictional disputes among building trades unions. At the departmental convention in Denver, held the week preceding the general A.F. of L. convention there, a group of seven of the larger unions, headed by the carpenters and including the bricklayers, electrical workers, hodcarriers, operative engineers, teamsters, and tile setters, were successful in a move to throw out the incumbent officers and substitute their own slate. Their action was taken over bitter opposition from a group of twelve of the smaller unions, comprising the asbestos workers, boiler makers, iron workers, elevator constructors, granite cutters, lathers, sheet metal workers, painters, plasterers, plumbers, roofers, and stone cutters.

The threat to the arbitration machinery set up last year, with Dr. John A. Lapp as referee, lay in the fact that that machinery depends for its success upon substantial unanimity among the unions in the department. If the split which developed in Denver is carried away from the convention, successful operation of the plan might easily become impossible.

A further threat to the arbitration machinery is provided by the fact that the carpenters, now the dominant group in the department, have taken the lead in opposing that portion of the plan which provides for settlement of local disputes through arbitration machinery set up in the local building trades councils. This position of the carpenters has already led to a brief general strike in Indianapolis last month (*ENR*, Sept. 23, 1937, page 494) which was called by the Central Building Trades Council to make the carpenters accept an arbitrated decision. That strike was won by the council, when, after three days, the building contractors in the city laid off their carpenters and the other trades went back to work. A week later a settlement was effected, the nature of which was not disclosed, and the carpenters were taken back on their jobs.

The building trades department adopted a resolution calling for revision of the federal housing act to make more funds available, eliminate the cost limitation amendment and the amendments providing that old buildings must be destroyed whenever new construction is carried out and that local authorities must put up 10 per cent of the cost. The resolution also suggested the establishment of local labor housing committees by building trades councils.

Inter-union strife of a broader nature dominated the opening of the general A.F. of L. convention Oct. 4 President Green opened the convention with a violent attack upon the C.I.O. and a demand that the federation expel the suspended C.I.O. unions and charter new unions in their fields.

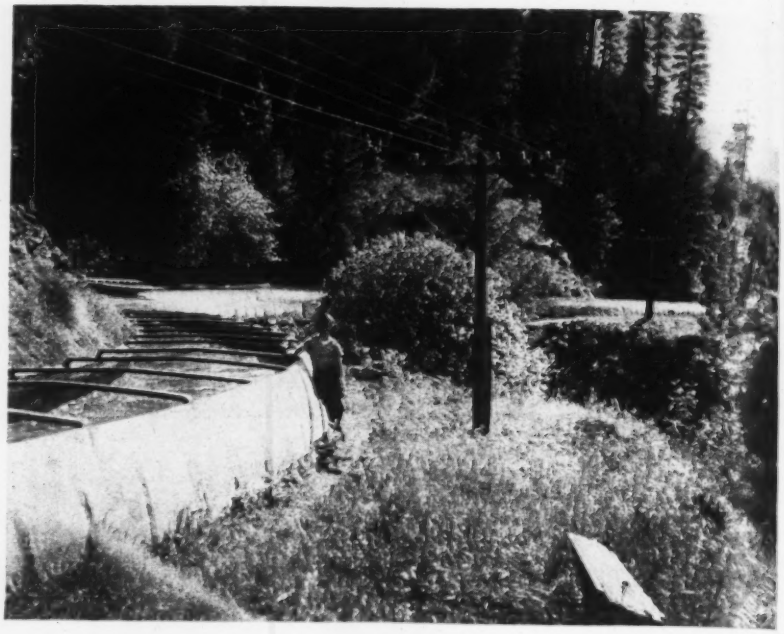
The report to the convention of the executive council of the federation echoed Mr. Green's position on the C.I.O. unions. It recommended a constitutional amendment which would permit the calling of special conventions with power to suspend or revoke charters, and an amendment giving the president of the A.F. of L. power to discipline state federations, city central bodies, and local and federal labor unions, including authority to suspend or expel officers and to suspend or revoke charters. Amendments were recommended which would prohibit central bodies from admitting delegates of locals allied with a dual organization or unaffiliated. A further proposed amendment would give the executive council broad powers during the interim between conventions.

Commenting on the work of the National Labor Relations Board, the report said that the board had made a notable record in mechanical administration of the act, but claimed that it was letting itself be drawn improperly into inter-union conflicts.

The report stated that the federation will push efforts at the next session of Congress to strengthen the Walsh-Healey government contract act, that the membership of the Federation had risen to 3,272,000, and that unemployment throughout the country had dropped by 1,961,000 to 7,800,000.

A shorter work week for employees of the St. Louis, Mo. department of public utilities is provided for in a compromise agreement, between officials of the department and the Central Trades and Labor Union, which provides that the 314 employees, who have been working about a 48-hour week, will work 40 hours per week for three weeks and 48 hours for one week during each month. The agreement affects 110 men in light and power and 204 in the water department.

Employees of the Oklahoma state highway department are not so fortunate. The department dismissd 350 more employees on Oct. 1, following out an economy program, to pay off $6,000,000 of delinquent bills, which has already resulted in total dismissals of about 1,150.



MAN-MADE RIVER

RESURFACING the inside of the Tieton Main canal of the Yakima federal reclamation project has effected a material increase in the carrying capacity. The Tieton Canal brings water stored in the Cascade Mountains, on contour along the foothills above the dry valleys which open onto the Columbia Basin plain, to irrigate the Yakima project.

Beach Protection Is Discussed

Engineering features get informal attention from Shore and Beach Preservation Association

Engineering aspects of beach protection were discussed informally during the mid-year meeting of the American Shore and Beach Preservation Association at Chicago, Sept. 27. Members of the association were conducted on an inspection of the Chicago waterfront improvement projects by Linn White, consulting engineer of the Chicago Park District, who has been in charge of the work for more than twenty years.

The meeting was opened by George T. Donoghue, general superintendent of the Park District, who declared that shore protection is the joint responsibility of the city, the state and the federal government. Mr. Donoghue said the Park District hopes eventually to secure the entire lake front of the city and, with engineering assistance, to build beach along its entire length, except for channel openings to yacht harbors and lagoons.

Engineers are now engaged in a study to determine whether special protective steps will be necessary at the State Sand Dunes Park in 1940, when the usual eleven-year cycle high water levels are expected on Lake Michigan, Myron L. Rees, director of the Indiana State Department of Parks, Lands and Water Conservation, told the meeting. Several years ago one storm piled up a strip of sand about 300 feet wide in front of the seawall at the park, and the state is anxious to protect or maintain it if there is any danger that the high water levels will remove it.

Colonel E. H. Marks, U. S. Engineers, district engineer at Galveston until a few months ago, described the construction of a series of groins at Galveston last year to protect the base of the seawall and restore the city's beach. Colonel Marks explained how the outer ends of the groins had been changed in design so they gradually sloped until the tops were level with the Gulf floor. The beach already is showing signs of being reestablished.

Victor Gelineau, director and chief engineer of the New Jersey State Board of Commerce and Navigation and a civilian member of the Beach Erosion Board of the Corps of Engineers, expressed the opinion that shore protection on the Great Lakes differed in no real degree from the problem on the Atlantic coast, and that nearly all protective devices used there had their place on the lakes.

Since passage of the federal Beach Protection Act of 1936 the Beach Erosion Board of the Corps of Engineers, in making its recommendations to Congress for federal financial assistance, based on "federal interest" in beaches, has decided that "federal interest" consists only of federal property, J. Spencer Smith reported. It will be necessary, Commissioner Smith said, for beach communities to secure an amendment to the law providing for federal assistance based on "public" interest or some better description of the use of beaches by non-residents.

At the same time, Commissioner Smith told the meeting, "the communities or people directly enjoying the riparian rights are essentially trustees. Their actions and their attitude should be that of trustees. When you think of water fronts from this angle, your perspective changes.

"Our water fronts are a common heritage and are part of all the land and not just that portion to which they are attached. If this be so, then the people occupying all the land have an inherent right to these shorefronts."

• • •

Highway Officials Break Records

(*Continued from page 578*)

divisions; urging the states to continue planning divisions to study highway problems and fiscal policies; asking Congress to authorize funds to continue construction of highways in forests, public lands, national parks and Indian reservations; and appreciation to the New England states committee and others for their work in making the convention a success. These were passed unanimously.

Other committee recommendations in various fields included plans for earlier economic studies of road projects, establishment of a clearing house for legal information on highway subjects, reduction of waste in connection with plans for handling entrances upon superhighways from private lands, recognition of the value of the forthcoming association publications on bridge practice, road specifications, materials standards, and other highway matters.

C. H. Purcell, state highway engineer, California, was elected president, the regional vice-presidents being L. D. Barrows, Maine; W. Vance Baise, North Carolina; A. C. Tilley, Nebraska; and H. F. Cabell, Oregon. W. W. Mack was re-elected treasurer, and executive committee members elected were P. G. Peterson, Utah, and T. S. O'Connell, Arizona. W. C. Markham, Washington, D. C., is executive secretary.

PWA Enters Actions Against Defaulters

Court action taken against borrowers defaulting on PWA loans

Failure of the city of Point Pleasant, W. Va., to make payments on bonds held by the Public Works Administration has resulted in a suit against the city in the U. S. District Court for the Southern District of West Virginia. The action, according to PWA officials, was taken after attempts to negotiate the difficulty with city officials had failed, and after an investigation.

A loan of $81,000, together with a grant of $30,000, was made to the city Nov. 14, 1933, for the construction of a combination sewer. Subsequently PWA accepted special obligation coupon bonds to the amount of $90,000 which were issued under state law and ratified by the City Council. Construction was started in August, 1934, and completed in February, 1935.

As a result of a similar action by PWA, the federal court at Fort Smith, Ark., ordered a receivership for the Second Sewer District at Harrison, Ark., on complaint that the city of Harrison was in default on the principal and interest on a PWA grant for construction of a sewer system.

The court action arose from a controversy of several months standing. The city of Harrison authorized issuance of bonds in 1935 to the amount of $97,000 which were purchased by PWA. The sewer system has been completed, but the city council has refused to accept the sewer system or put it into use, charging that it is defective, not constructed according to specifications, and unfit for use.

As of August 31, 1937, PWA had loaned a total of $644,500,000 with an aggregate default on payments of $1,061,763, less than 0.2 per cent. Commenting on this situation E. H. Foley, Jr., PWA's general counsel, reported to Administrator Ickes:

"Some of these defaults have been only technical and have either been cured or, in the opinion of the administration, will be cured. Others, however, have resulted from such an apathy and indifference in operation and management on the part of officials of local public bodies that the administration has not been able to have any confidence in the prospective curing of such defaults. In such cases . . . the only remedy is a replacing of the present management with a more aggressive one and . . . the filing of a bill of complaint . . . asking that a receiver be appointed."

Big Power Plant In California

Sacramento asks permit to build 201,000 hp. hydroelectric plant in Eldorado County

The Sacramento municipal utility district of Sacramento, Calif., has filed an application with the Federal Power Commission for a preliminary permit to build a 201,000 hp. hydroelectric project on Silver Creek and the south fork of the American River.

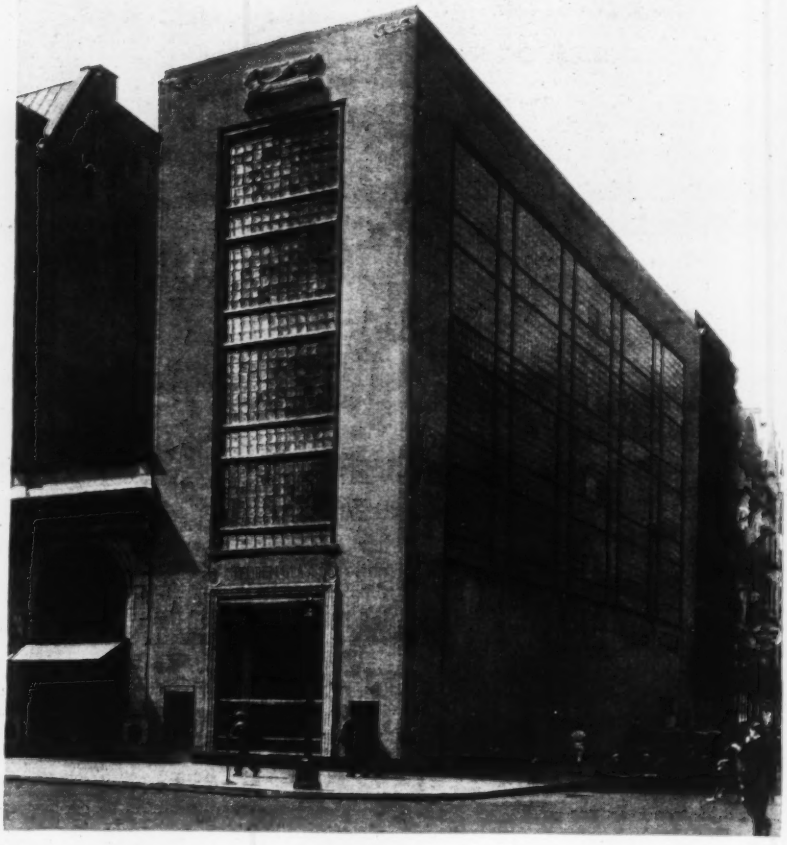
The ultimate development will consist of two storage reservoirs connected by a tunnel, three diversion conduits, and three power houses. Construction would be carried on in two steps, the first of which, developing about 55,000 hp., would include only one power house.

The proposed initial development will consist of a diversion dam at Ice House on the south fork of Silver Creek, creating a reservoir with 5,000 acre-ft. storage. A second dam at Union Valley, below the confluence of the middle fork and the north fork of Silver Creek, will create a reservoir with a storage of 60,000 acre-ft. A third diversion dam will be built on Silver Creek above Big Bend, and a diversion tunnel will connect the Ice House reservoir with the drainage basin of the Middle Fork and Silver Creek above the Union Valley reservoir. A conduit from the Big Bend diversion dam will run to a power house at Rush Creek.

Initial transmission facilities will consist of two circuits on separate towers from the plant to Sacramento.

When the proposed ultimate development is made, the Ice House dam will be raised to create a storage capacity of 45,000 acre-ft., and the Union Valley reservoir will be enlarged to a storage capacity of 180,000 acre-ft. Two new diversion tunnels will join the Union Valley reservoir to a forebay above Big Bend. A new power house of 48,000 hp. capacity above Big Bend will be operated through the Big Bend diversion scheme used in the initial development, and the Brush Creek plant will be enlarged to an installed capacity of about 102,000 hp. A second new power plant will be installed at Chili Bar on the south fork of the Amercian River with a capacity of of about 51,000 hp. This will be operated by a conduit from the afterbay of the Brush Creek plant.

The ultimate transmission facilities will consist of two separate power lines from the Big Bend plant to the city of Sacramento, with inter-connecting lines from the Brush Creek and Chila Bar plants.



PEOPLE WHO WORK IN GLASS HOUSES

THE NEW office building of the Corning Glass Works, which was opened in New York City Sept. 27, is the first office building to use glass brick throughout. The upper floors of the building will be occupied by offices of the Corning Glass Works and its affiliates and the lower floors by sales rooms.

Glass in 25 varieties is used in the construction of the building. Corning construction blocks of Pyrex glass have been used in the outer walls and inner partitions, while the Macbeth-Evans Lumite Block has been used inside.

City Planning Research Organized at Buffalo

Walter C. Behrendt, formerly executive officer and consultant on housing, planning, and building in the Prussian ministries of finance and health, has been made technical director of the Planning Research Division at Buffalo, N. Y., a project sponsored jointly by the University of Buffalo and the Buffalo City Planning Association.

The research station will include on its staff senior and junior "interns," who will make studies under Dr. Behrendt's direction. The senior interns will be graduates of accredited schools of architecture, engineering, and related subjects who are looking forward to housing administration and city and regional planning as a career. The junior interns will be students in social and public administration in the school of social work at the University of Buffalo. The project is assisted by a grant from the Rockefeller Foundation.

Dr. Behrendt will be professor of city planning and housing at the University, and in addition to his work at Buffalo he will be visiting lecturer at Dartmouth College where he has been teaching recently.

. . .

Raise Roof of Building To Add Story

Work has begun at Louisville, Ky. on a $168,200 project to insert a sixth floor on the federal building there. Plans call for lifting the present roof of the building by jacks as the new walls rise beneath.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Specifications Not Followed

Sir: In mixing concrete why make so much theoretical fuss over the amount of water to be used? Many specifications call for about six gallons of water for a bag of cement, but I have yet to meet or hear of a contractor who intends to follow that specification. It is certain that foremen feel it incumbent on them to put enough water in concrete so that it handles very easily. As a carpenter on a grade crossing elimination recently said, "As soon as the inspector went away enough water was put in the concrete to make up for dry mixtures. You can't get a smooth job without it."

Is the inspector supposed to stand by the mixer doling out the water in a gallon measure? Why should foremen continually be allowed to make monkeys out of conscientious inspectors? An inspector cannot enforce adherence to specifications unless his superiors back him up, and it does not seem to make any difference if the work is done by contract or by day labor. I wonder if there is a single engineer specification writer who is certain that his water control requirement has been complied with.

Oct. 1, 1937 C. J. WILKIN.
Gardiner, N. Y.

In Defense of Zoning

Sir: I read with considerable interest, the article by W. L. Henderson titled "Zoning is a Failure". (*ENR* Sept. 9, p. 425). Having had experience in this line I am moved to take issue with some of his remarks.

It so happens that I was Building Inspector in this city at the time our local zoning ordinance was passed. One of my first duties was to swear out warrants for the arrest of persons constructing an apartment house in the residence district in the face of a then existing ordinance requiring a consent petition signed by 60 per cent of the property owners adjacent to the proposed structure. Not being able to obtain sufficient signers the apartment building was started with the resulting recourse to the courts to test the validity of the ordinance.

The State supreme court decided that in the absence of a comprehensive zoning ordinance the existing ordinance was discriminatory and therefore invalid. This litigation covered a period of several months and in the meantime three small homes were built close to the street line on the site.

This resulted in an equally objectionable condition but was one over which our old ordinances had no control. Our present zoning ordinance would have prevented this condition by requiring a uniform setback and limiting the number of houses which could be built on a given area.

A hundred years ago the courts would probably have held the rights of the individual property owner inviolable but in this day of organized society our lawmakers, in their wisdom, have recognized the rights of adjacent owners whose property values might be depreciated or enhanced by the type of use to which it could be put.

Mr. Henderson states that "City zoning practice has been harmful because of its confiscating nature and the frequency of amendments and exceptions". Of what law which is passed for the common good cannot this same thing be said? Just so long as men judge will there be errors in judgment and our existing zoning ordinances are not free from these errors. If it were not for the possibility of amendment there would be no way to rectify these conditions. In any growing and progressive community the character and use of real estate changes and a workable ordinance should make provision for a change in use classification when it is in the interests of progress and changing conditions.

Voluntary restrictions applied to neighborhoods to obtain protection as suggested by the secretary of the National Association of Real Estate Boards in my opinion and experience will not work. There is usually someone who cannot see beyond the horizon of their own selfish interests and unless curbed and restricted by a comprehensive zoning ordinance irreparable damage may be done to adjacent property.

The principle of zoning should be unassailable and it will be interesting to read what others may think of Mr. Henderson's extremely broad condemnation.

Sioux City, Iowa GEO. W. SMITH
Sept. 25, 1937

Railroad Engineers Pay

Sir: I read Mr. Millard's letter (*ENR*, Sept. 2, p. 377) with considerable interest, but cannot but wonder whether the pay figures he gives are not those of pre-war days. During the war period, as I recall, when railroad operating men were getting pay increases, the engineering societies took a hand in the negotiations and got very considerable increases for the men in the engineering.

There is another angle to the pay question which Mr. Millard discusses: He sets his $83 a month as a resident engineer over against $100 paid a brakeman. On railroad construction work with which I am familiar the company provided food and camps for the engineers, hence the pay check was not an accurate measure of the total compensation.

I have often known engineers in railroad service to compare their pay with that of the train-service men in a manner that did not make an equitable comparison, and the same sort of comparisons are made today on other jobs where engineers work beside carpenters, etc. The older men in train service are well paid and have steady jobs, but the young men may get good pay when the traffic is heavy, but often they find themselves on the "spare board" when the pickings are poor. Similarly, a carpenter may be getting $12 or $15 a day when he is working, but his *average* pay throughout the year is much lower than that would indicate. The man on a fixed monthly rate that comes rain or shine overlooks this.

I don't mean to imply that the pay of engineers in railroad service—or in many other fields for that matter—is adequate when compared with pay in other lines, but it is not as far out of line as snap judgment would indicate.

Sept. 30, 1937 GEORGE LYMAN.
New York

ENGINEERING NEWS-RECORD

Copyright 1937, by McGraw-Hill Publishing Company, Inc.

Volume 119, Number 15

Editor, F. E. SCHMITT · *Editorial Staff*, V. T. BOUGHTON
N. A. BOWERS, W. G. BOWMAN, W. W. DEBERARD
C. S. HILL, H. W. RICHARDSON, E. J. CLEARY

Editorial Offices at 330 West 42nd Street, New York

OCTOBER 7, 1937

CHANNEL CLEANUP as at Fitchburg is the very first step needed in the control of floods. Costly operations to reduce flood volume are useless while key points along the discharge channel are blocked by neglect and encroachment. The conditions involved are found in so many cities and municipal neglect concerning them is so common that the details of this particular case need no emphasis. But the Fitchburg work illustrates the extent and diversity of the corrective work often required, and also brings out the value of the civic improvement realized. Such channel clearance obviously bears a close relation to city planning, and it is apparent that foresighted planning can do much to prepare the way. City officials especially will find it useful to study the work at Fitchburg as a practical example of a type of improvement that should have priority in a city works program; for, though federal money is paying for this one job, channel clearance for local protection is undeniably a local responsibility.

The Main Job Waits

WHILE CHANNEL IMPROVEMENT is being provided at Fitchburg, Haverhill, Springfield, Hartford and a few other critical points in the New England flood region, the main part of the job of erecting defenses against great floods like that of March 1936 has not been begun and is making no progress. The stalemate between federal government and the states involved appears to be complete—the federal government refuses to proceed with the control reservoir construction authorized by Congress unless the states sign over all power rights to Washington, and the states are unwilling to do this. As the power values in these reservoirs concerned are negligible, the dispute revolves around the principle concerned. The federal government lacking constitutional right to seize or control hydraulic power within state territory, seeks to force its cession. The states resist, knowing that yielding would open the way to further surrender of state governmental authority. The situation clearly dictates that the states should proceed by themselves, in order to protect their own river valleys and industrial centers, but this also is impossible until an interstate treaty receives federal approval. The whole regrettable situation, for which no solution is yet apparent, gives added importance to local protective works.

Back Over Old Ground

TIME AFTER TIME in the past engineers have examined the pros and cons of buying consulting service as part of a bill of goods or a construction contract. The conclusion is well established: that the client's interest demands rigid separation of the functions of engineer from those of contractor or seller; exceptions are limited and generally minor. Now, going back over the old ground, Hackensack raises the question again by calling for bids on a sewage-disposal plant, the bidder to design the plant he proposes to build. Performance figures are specified and a site has been chosen, but all other elements of the plan in which the skill and experienced judgment of the disinterested consultant should guide are left to the bidder and presumably will be appraised according to bid price. A special feature of the case is the requirement that plans must be approved by the state board of health, which may result in placing this body in the virtual position of consulting engineer to the city—a specially difficult position because the bidding is not truly competitive, since the alternates called for are not commensurable and thus permit of arbitrary decision. Even apart from these circumstances, however, Hackensack's unconventional procedure is the day's prime news in engineering. In its nature it is an open challenge to recognized principle, while in respect to practical results the outcome must show whether the city will get the plant that it needs at least cost.

Old Bridges

BRIDGE ENGINEERS AT last week's convention of the American Association of State Highway Officials concentrated discussion on their most urgent problem—the loads that will use and are using their bridges. Largely it was a labor of futility, for highway bridge engineers, unlike railway engineers, have no control over their live loads. Such control as exists is exercised by indefinitely worded legislative acts and, in the final analysis, by law-enforcement agencies. And new trucks and rumors of trucks from the transport industry accentuate the difficulty. Most serious is the problem of old bridges and their proper posting and inspection. If bridge engineers followed their consciences in alloting factors of safety to these old structures as they do with the new ones, highway transport would be ruled off of thousands of miles of road. Necessarily they must compromise and use lower factors of safety in arriving at values for posted loads; but

even then there is no assurance that the posted notices will be obeyed. Sooner or later a bus load of school children is going through an old bridge that has been weakened by continuous overloading. It will be a heavy price to pay for attention to the pressing problem of traffic enforcement and bridge modernization.

Looking Ahead

TWO DECADES of notable accomplishment lie behind the American Association of State Highway Officials, which at Boston last week held its twenty-third and largest-on-record annual meeting. In these twenty years the association's opportunities have been great. Yet greater opportunities lie before it in the decade to come, for greater problems face highway transport.

The Association of State Highway Officials is in a unique position among organized groups of highway interests, indeed among technical and business associations of all kinds. Its members are state highway departments and the federal bureau of public roads; its acts are deliberated and have almost the force of official pronouncements; in effect its members control the highway development of the United States. These powers have been well exercised for constructive development through a score of years. The record is worth attention.

The record includes the inception and in large measure the drafting of the federal-aid laws of 1916 and 1921 and subsequent highway acts. Out of this legislation have come organized highway departments in every state; state and federal-aid road systems defined and physically numbered and marked for nearly 450,000 mi., the construction of 350,000 mi. of surfaced road, nearly all within the twenty years. And a by-product is one of the greatest aggregations of research laboratories and technicians in the world.

This much has been said of the organization and accomplishments of the Association of State Highway Officials so that it may be understood what its powers and duties are in dealing with the questions ahead. These questions are numerous: taxation and financing; system planning; modernized administrative system; traffic control and regulation; public support; comprise only a few of many, all of which are full of problems.

Specifically, how are we to finance the self-contained wide rights-of-way needed to prevent the crowding in of business along costly bypass and city access roads? At the meeting in Boston, Thomas H. MacDonald, Chief of the Bureau of Public Roads, called for these land costs to be paid by long-term bond issues.

Again, is a highway elevated over the city street a better solution than a restricted right-of-way? What place has the express highway in road transport economics? And what do we know of the proper construction of such thoroughfares?

And, further, what knowledge have we about the soil stabilization processes that are spreading like a craze among our builders of secondary roads? Or, as to administration, how are we to stabilize our highway departments so that they are not upset every two or four years by new political administrations? Will placing them under civil service be the answer?

These are among the questions that crowd in on the highway officials of America and their official association. Gradually the association members are beginning to organize to answer them; the new committee on administrative design is an example. But the process needs hastening.

Materials, pavement details, bridge details, maintenance procedures, specifications will always be subjects of important committee work, but broader association work is ahead. The highway officials of America are being called upon to create and perfect a national system of highway transportation. It is a challenging demand worthy of the highest engineering skill.

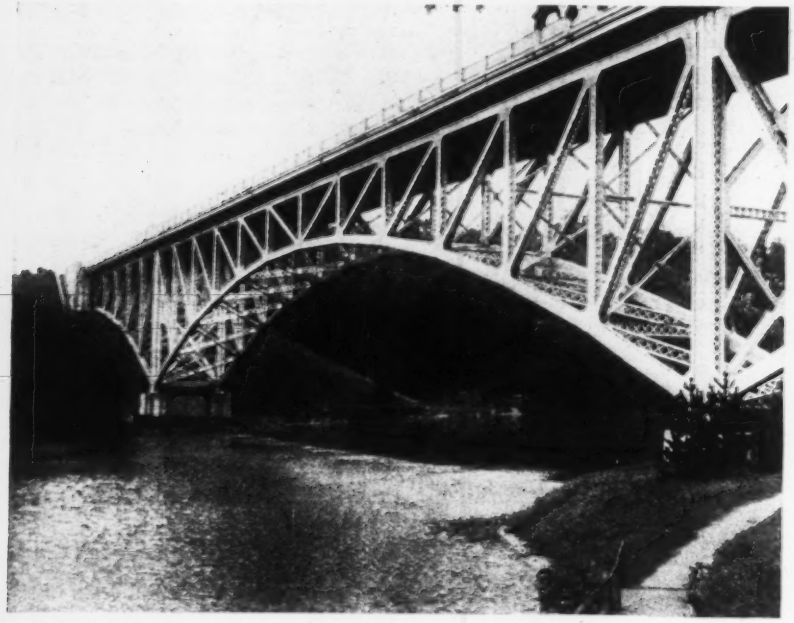
Three Meetings

THE HIGHER INTELLIGENCE that makes the schedules of engineering meetings and conventions outdid itself in framing up the conjunction of this week's three conventions. The American Society of Civil Engineers meets at Boston, the National Society of Professional Engineers at New York, and the Federation of Architects, Engineers, etc., at Detroit—not to mention public works officials at Atlanta and the mechanical engineers at Erie.

Every live civil engineer has a substantial concern in the doings of each of the three organizations, and if he could attend the sessions of all he would find it profitable, especially as economic matters close to the heart of the profession will be on the floor at each meeting. The Civil Engineers' program includes discussion of when a public improvement is wise and when it is wasteful; the Professional Engineers will deal with the problem of strengthening professional qualifications by enforcement of license laws; the union brethren at Detroit will discuss organizing to get higher pay plus shorter hours.

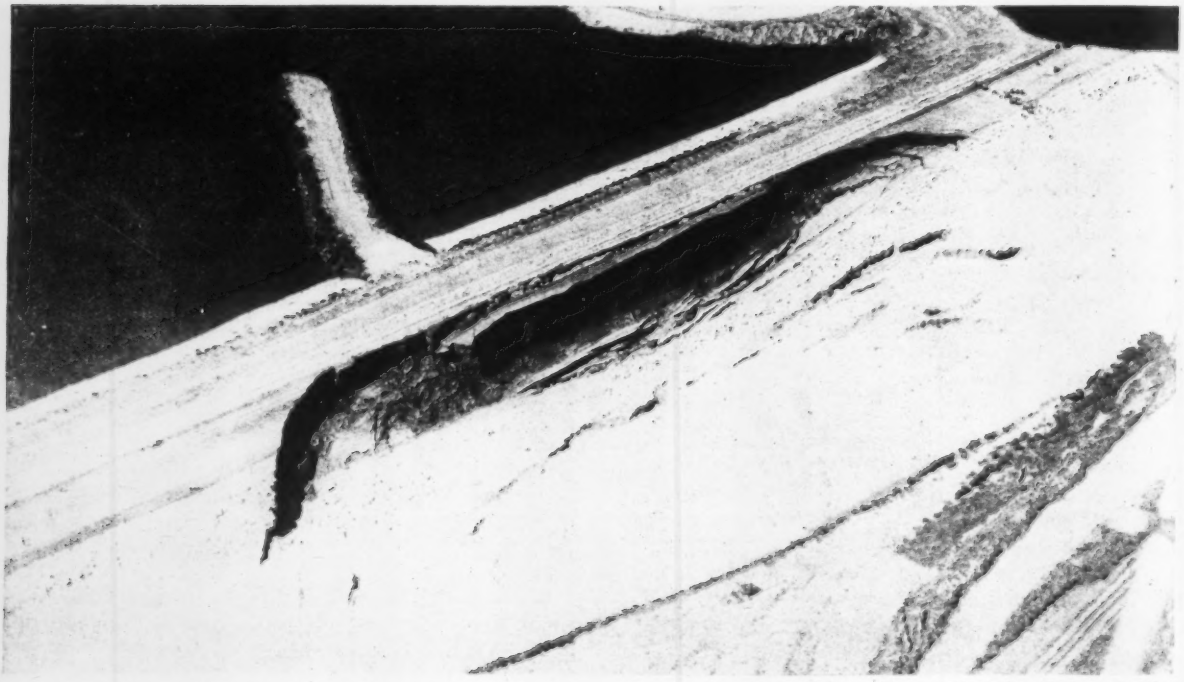
Each of the three groups has a direct stake in the subjects that the other two are discussing, and ought to have opportunity to be present in person to hear the discussion. Perhaps some future generation will evolve a convention scheduling system that will bring such meetings together in the same city on immediately consecutive dates.

PICTURES IN THE NEWS



ENR Staff Photo

NAMED FOR AN ENGINEER. *Pine River Bridge west of Cadillac, Mich., named Cooley Bridge in honor of Mortimer E. Cooley, has been made the center of a park laid out by the state highway engineers.*



Transcontinental & Western Air Photo

MARSHALL CREEK DAM *after the slump, as photographed by the pilot of a passing TWA skyliner. Cracks along the road across the lower right corner of the picture indicate the upthrust of the surface at the outer limit of the earth movement.*

GREATER CHANNEL CAPACITY AND BANK PROTECTION ARE THE BASIS OF FLOOD PREVENTION IN FITCHBURG.

No More Floods for Fitchburg

This Massachusetts industrial city is protected by extensive channel improvements on five-mile reach of North Nashua River

In the 1936 flood, waters of the North Nashua River went on a rampage through Fitchburg, Mass., for the tortuous, rubbish-choked stream channel was wholly incapable of carrying the excessive waters. Property damage from that one flood exceeded $2,000,000, and many lesser floods in the past have taken a smaller but still significant toll. In the future, floods of the 1936 magnitude should pass harmlessly through the city, for a $2,000,000 channel improvement, which will provide an adequate floodway on a five-mile reach of the river is being carried out by the Army Engineers with WPA funds and labor.

From the standpoint of flood control the Fitchburg work is of interest because it is typical of local protection that will be done in hundreds of communities under the flood control act of 1936; its construction is also of interest because of the great variety of operations and the difficulty in planning them.

Fitchburg is an industrial city of 45,000 population, lying in the deep, narrow valley of the river about 50 miles northwest of Boston. Above the city the river has a drainage area of 65 sq.mi., mostly rough and rocky country conducive to rapid runoff. The normal flow of the stream at the city is 100 sec.-ft., though a range of from 15 to 3,000 sec.-ft. is common. During the 1936 flood the flow was estimated at 10,000 to 11,000 sec.-ft. The improved channel will accommodate 9,000 sec.-ft., which, with some regulation by upstream reservoirs, will provide adequate protection.

The city is typical of old New England mill towns It grew up around scattered industrial plants which utilized the rapid fall of the stream for water power. The river winds through the center of the city, and streets and railroads cross the stream innumerable times in great confusion. As the industries developed, eleven low diversion dams were built for power purposes; their spillway width usually was too narrow for ample floodway. Many of these dams were abandoned long ago and had fallen into disrepair. Plants and industries encroached upon the normal stream channel. Old stone retaining walls were supposed to keep the stream within its restricted channel, but many of these ancient structures had collapsed and their debris further obstructed the stream flow. In the five-mile length the river is crossed by 28 bridges of various types, some of which have inadequate waterway clearance.

In addition to all the structural obstructions in the stream channel, the citizens for years have regarded the river as a dumping ground, and as a result the stream became almost completely clogged in places. Little wonder therefore that Fitchburg suffered from the flood of last year—there was little place for the waters to go except down the streets.

From the above description of existing conditions it can be realized

Fig. 2. New concrete wall and a deepened channel provide a definite floodway in place of a former meandering and choked streambed. Note the depth of the new channel, for which the first cut has been made along the wall.

that the Army Engineers faced a difficult problem when they started to plan the Fitchburg flood-control project. The basis of design was to provide a channel of 80-ft. bottom width with walls or banks at least 13 ft. high for a flow depth of 10 ft., leaving a 3-ft. freeboard. As the stream bed is mostly glacial till subject to erosion, the design contemplated a series of drops with the new channel floor between drops on a grade low enough to prevent bottom and side scour. This plan required considerable channel excavation, both widening and deepening, to change the stream from its original steep course to a series of flat slopes. In many places it was necessary to provide walls or dikes to obtain the 13 ft. depth of floodway.

Naturally, with the wide range of conditions, there is little in the design and construction that can be called typical. The program required working out suitable details for almost every foot of the improvement. It was found that 5 of the old dams were no longer of service and so could well be removed. One additional dam was built to carry flashboards designed to go out in a flood and another was removed after the power rights had been purchased by the city of Fitchburg.

One single-track pile trestle of the B.&M.R.R. had to be entirely rebuilt and extended to clear the new channel; another was removed. A highway bridge required a new center pier because of channel deepening, and several piers on other bridges had to be underpinned. At two major street crossings the city is replacing old structures with new ones of greater span.

Fig. 4. Shovels took to the river bed, and so did the trucks, in much of the channel excavation when the flow was small.

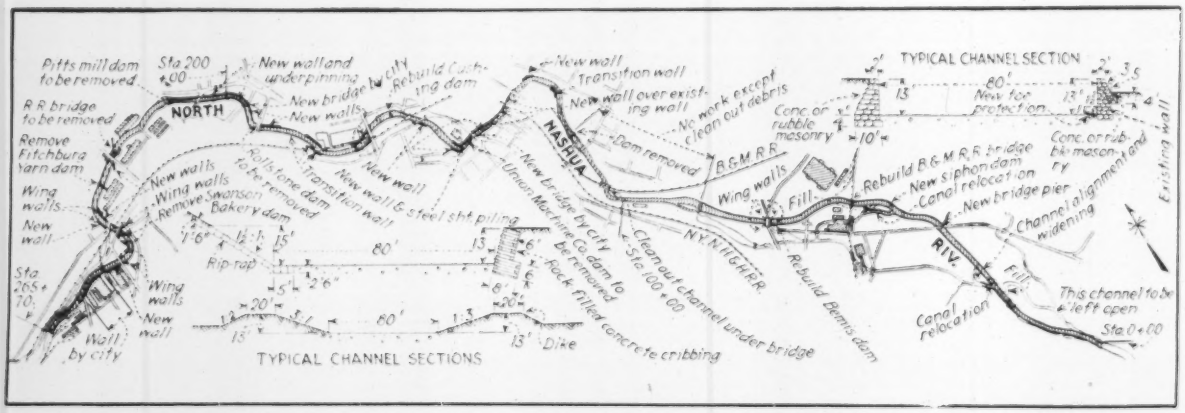


Fig. 3. Fitchburg has been in a flood trap for years, because of the obstructed, winding course of the North Nashua River. The current improvement program provides adequate floodway.

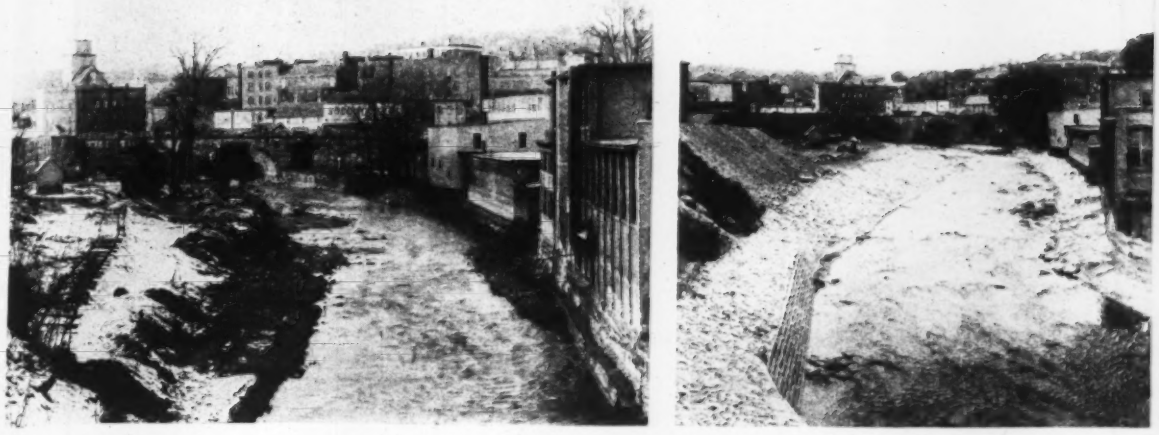


Fig. 5. Typical "before and after" view of the Nashua River improvement to end the flood menace in Fitchburg. This is but one short stretch in the five-mile project. Note riprap toe protection for the old walls.

A sum of $1,800,000 was allotted to the Army Engineers from WPA funds. The city provides all right-of-way and easements required, and is spending about $200,000 for land damages alone. In planning the detail treatment of the old channel the engineers worked on a total cost basis, or the same as if they were paying for the entire costs. In general, where land was cheaper than walls the banks were sloped and protected with riprap where required; where land was of higher value a concrete crib wall was built to reduce the amount of side slope; and in cases of very high land costs or the presence of valuable buildings, vertical concrete or rubble masonry channel walls were built.

Details of design

At the lower end of the project in more open country the channel was built with 3:1 side slopes, and where necessary to get the 13 ft. of depth, dikes of 20-ft. top width were built on one or both sides. At sharp bends the concave banks are protected by 18 in. of riprap of field or quarry stone; here the banks are steepened to 2:1 slopes. Further upstream, as property becomes more valuable, concrete crib retaining walls are used in place of the sloped banks. These walls, of 6-ft. or 8-ft. headers, are pitched on a 1:4 batter and are completely filled with stone. Cribs have been built up to 18-ft. in height.

At several locations old rubble walls exist, but invariably they are too low for the new channel wall

height. In such cases it is necessary to either replace the old structure or to raise it. The latter course is followed if the existing masonry and its foundation are in good shape. Either stone or concrete is used in the raising, depending upon local conditions. Wherever an old wall is to be left in place a toe protection of heavy stone is placed to prevent underscour. Sometimes this toe is grouted to insure its stability.

Some places require a high stone or concrete wall, and often such a wall is tied into flanking stretches of concrete cribbing. The transition between crib and wall and between crib and sloped bank is usually a grouted rubble masonry section warped to fit. All of the new walls are on spread footings. Alongside low industrial tracts, steel sheetpiling is driven under the walls to prevent percolation under the structure.

Often it was necessary to design the structures and to plan the method of treatment of a reach of the river

Fig. 6. Two ways of handling precast units for the concrete crib walls. Top—the units are carried in by hand; bottom—a traveling cable hoist saves much heavy lifting.

Fig. 7. Full use was made of efficient and adequate construction plant wherever possible, as is witnessed by this concrete pumping layout for pouring a large wall. In the background of the right view is evidence of the original condition of some of the banks, which are being trimmed up and protected by walls of various types.

after the construction forces were on the job and had uncovered the site to reveal the true conditions.

Every effort has been made to cooperate with the municipal authorities. If, for example, the extending of a wall a few feet will greatly benefit the community as a whole without excessive cost, the work is usually done.

The utilities are taking care of their own lines, lowering or relocating as necessary to provide for the deepened and widened channel. All sewer changes within the improvement limits are being made as part of the project.

Construction plan

The work was set up on the basis of using hired labor and government-owned or hired plant. Efforts were made to obtain a balance between efficient plant operation and the useful employment of as many security wage earners as was consistent with reasonable operating costs.

While the work is entirely under the direction of the Boston District office, three separate departments have been set up—design, operations (construction) and inspection.

Plans and complete specifications are drawn up by the design department. Unit prices are established for each item of work, and the construction department is required to meet them. Inspection is by a separate department, and is carried out exactly as if the job were being done by contract.

While no single structure is of great size, the total quantities involved are impressive. Excavation will run 500,000 cu.yd.; 65,000 sq.yd. of riprap is required; concrete, 15,000 cu.yd., rubble masonry, 8,200 cu.yd. and concrete cribbing, 3,100 cu.yd., are other important items.

Some of the equipment, such as compressors, pumps, tractors and bulldozers, rock drills, trucks, and even a crane or two, is government owned, mostly acquired from the defunct Passamaquoddy project. Small tools and miscellaneous small plant were bought for this job, while most of the power shovels, cranes, draglines and trucks are rented with operators furnished by the owners. Concrete is purchased from a commercial ready-mix plant, delivered to the job. A concrete pump is used for delivery to parts of the job inaccessible to the trucks. Quarry stone riprap is purchased from local quarries, delivered to the site. Concrete cribbing is secured from a commercial plant in Boston and trucked to the job.

About 1,000 WPA workers are on the job, working two shifts six days a week. Workmen of different grades work a different number of hours per month, which complicates the job of construction planning. All straw bosses and foremen are from WPA lists; the superintendent and his assistants are experienced construction men from the outside.

The work was started Sept. 1, 1936, and last fall and winter a good grade of workmen was available. However, this summer saw a large part of the better class of workmen going into private work. By careful planning of the individual operations to best utilize equipment, the unit costs have been kept within reason despite the untrained and inexperienced labor. There is a shortage of some classes of skilled help, especially carpenters.

The construction operations have been planned to keep certain gangs at one type of work as much as possible. Thus, the crews that build the concrete cribs are kept at that work, while the concrete and riprap gangs likewise remain at one task. Of course, some switching of workers is necessary because of a slackening up of one type of work and failure of many men to report regularly for work. The supervisory force often does not know just how many men there will be in any shift.

Construction details

Excavation of the new channel is by dragline, clamshell and shovel, with full use of trucks for haulage beyond the range of sidecasting. The stream bottom is gravelly, permitting both excavators and trucks to work in the bed. In summer the stream

Fig. 8. Granite riprap laid wide and deep will protect this bank from erosion during floods.

flow seldom interfered with excavation operations.

Where walls are to be built, one side of the channel including the structure foundations, is excavated in the dry within low earth cofferdams. Pumps take care of seepage into the cofferdams. Often, too, it is advantageous in case of deep channel excavation to dig one side first, keeping the stream to the other side by earth dikes. Bulldozers are extensively used for shallow channel excavation and for backfilling behind walls. Much of the excavated material is used for filling low ground and building up playgrounds and park areas, on shortest haul possible.

Riprap is dumped to place by trucks if possible, or at least within reach of a clamshell crane. Hand placement of riprap is limited to steep slopes where the stone is to be grouted, and to rearrangement of the stones in place.

Concrete cribbing is, of course, built up by hand. A deep bed of gravel is carefully prepared for the foundation of these walls and an extra bearing course of stretchers is placed under the toe. Crib walls are battered 1:4 for stability.

An interesting problem arose in building a high crib on a concave bend. This particular wall was built in chords of three sections each. The center chord was built first with its headers in vertical planes. However, because of the batter, the joint between adjacent chord sections would have opened into a V toward the top had all headers been placed in vertical planes. Instead, the adjacent headers and all those to each end from the center section were worked in toward the center to meet the adjacent sections, resulting in inclined files of headers. The appearance, however, is not objectionable, and the wedge-shaped ends are built out with grouted rubble masonry.

Concrete structures are built within lined wooden forms, and the appearance of finished structures is all that could be desired. Wherever possible, the concrete is dumped directly to place from the agitator trucks, while a concrete pump takes care of parts of the structures inaccessible to the trucks.

The project is not one large construction job—it is a series of small operations carried out under planning difficulties. The work is progressing rapidly and will be finished before the end of the present year.

For the most part the citizens and property owners are cooperating. Of course there is always the owner who demands unreasonable prices for needed land. Then, too, a few citizens have no conception of the purpose of the improvement, and in spite of all precautions, some dumping of rubbish and waste material has taken place in completed sections of the work. The mayor is seeking suitable ordinances to prevent such occurrences in the future. City and state officials generally are promoting adoption of legislation to prevent encroachment on stream channels.

Direction

The project is being carried out by the Boston District office of the Corps of Engineers under the direction of Lt.-Col. A. K. B. Lyman, district engineer. Capt. J. C. B. Elliott is in general charge of the operations; Capt. J. H. Stratton is in charge of design. J. J. Bernstein, associate engineer, is in direct charge of design for the Fitchburg project. H. C. Byrnes is field superintendent of construction and in local charge of operations. The Army Engineers work with a city flood control committee, which has no official standing, but which advises the city council and makes recommendations to that body. City engineer J. M. Peirce is the official representative of the city in collaborating with the engineers.

• • •

New Type Engine For the B. & O.

A NEW STEAM LOCOMOTIVE which is expected to reduce track stresses as well as produce higher efficiencies than heretofore obtained is now being built by the Baltimore & Ohio R. R. The locomotive is a radical departure from the conventional type. It will have 16 cylinders arranged for constant torque propulsion, each of the four driving axles being directly geared to a 4-cylinder Besler steam motor. There will be no counterbalancing, no side-rods or crank pins, thus eliminating the hammer blows delivered to the track by the conventional steam locomotive. Absence of side-rods will permit the driving wheels with their independently mounted motors to negotiate sharp curves without difficulty. Gears and other moving parts will operate in a bath of oil, as in an automobile. The cut-off position of the valve gear, together with the forward and reverse motion will be regulated from the cab by electro-pneumatic control.

The locomotive has a 4-wheel leading truck, four pairs of drivers each equipped with a 4-cylinder motor, and a 4-wheel trailing truck. It is expected to develop 5,000 h.p. and to be able to handle 14 standard Pullmans at 100 m.p.h. on straight track. Boiler pressure will be 350 lb.

Crest Lengths Classify Discharge

by ROBERT ABBETT

Assistant Professor, Union College, Schenectady, N. Y.

Classifying sharp-crested weirs according to crest length divides water flow into three definite zones

By classifying pipe flow into critical and turbulent regions, fluid mechanics has raised the question of whether it is not possible also to classify other flow phenomena. The following article classifies unsubmerged flow over sharp-edged rectangular weirs according to crest length by plotting results from experiments on eleven such weirs. Since such a weir classification is of fundamental importance, engineers might well subject other weir data to the same test. —EDITOR.

MUCH SPECULATION exists as to the causes of inconsistencies in various weir formulas proposed by honest, careful investigators. Some of these variations in weir formulas can undoubtedly be attributed to changes in approach channel conditions, but on the other hand, the discharge coefficient in the common theoretical formula has been found to vary with both crest length and head. If instead of using the theoretical value of 3/2 for the exponent of the head in the common weir formula, the correct exponent is determined, then the discharge coefficient will be found to vary only with the crest length. While so plotting the variation of the discharge coefficient and the exponent against the crest length for eleven experiments on sharp-crested weirs an interesting fact was revealed. In each of two zones the exponent has a constant value; in the zone between the other two it is variable. This condition is somewhat analogous to that existing in pipe flow where pipe flow changes from laminar to turbulent at critical values of Reynolds number.

In making this study, eleven sharp-edged rectangular weir experiments were used; five of these experiments being made by V. M. Cone in 1916. Crest lengths varied from ½ to 48 in., heads ranged from zero to 1 ft., and the weirs were sufficiently high to render the influence of the approach channel negligible. An interesting side light of these experiments is the nappe's ceasing to cling to the crest at practically the same head (0.08 to 0.10 ft.) for all weirs. The results of experiments on each weir were expressed by a formula of the type $Q = KLH^n$, and the discharge coefficient, K, and the exponent, n, for each of the eleven weirs plotted against the crest length, L (Fig. 1).

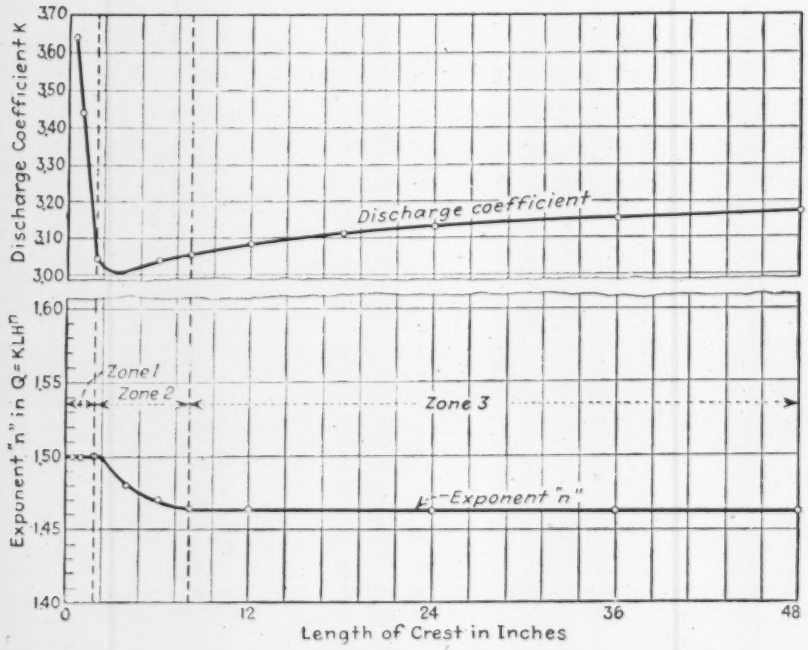


Fig. 1. Plotting variation of several weir characteristics with crest length indicates a possible three-zone classification of weir flow.

Crest length criterion

Study of Fig. 1 indicates that crest lengths between ½ and 2 in. have a constant value of 1.50 for the exponent, n, while crest lengths greater than 8 in. have a somewhat lower constant value of 1.465. Separating these two "constant value" zones is a transition zone in which the exponent's value varies from 1.465 to 1.50. A universal weir formula therefore seems impossible.

Weirs having crest lengths of less than 2 in. (zone 1) have little practical value at the present time, for they are really narrow rectangular slots, but under some conditions their properties do make their use suitable. In measuring small discharges the short crest-length rectangular weir does have an advantage over the triangular weir in that head variations have a lesser effect on the rate of flow and that errors in measuring the head produce smaller errors in discharge.

Critical weirs

Laboratory weirs frequently have crest lengths between 2 and 8 in. and thus fall in the transition zone 2. Results of tests on such laboratory weirs are certain to be misleading, therefore, if they are applied to weirs having crest lengths different from those tested. Each weir in zone 2 behaves according to its own individual law. If a weir in this zone is used as a metering device, a special calibration should always be made to avoid the error which the application of a formula is likely to produce.

The majority of weirs in practical engineering work have crest lengths exceeding 8 in. and thus fall in zone 3. Flow over the weirs in this zone can be expressed by the empirical equation

$$Q = KLH^{1.465}$$

where the discharge coefficient K is itself an exponential function of the crest length. This equation is not dimensionally correct unless K is also a function of H. In this case, the dimensionally correct equation is written

$$Q = C\left(\frac{L}{H}\right)^{0.035} LH^{3/2}$$

Aeronautical engineers will recognize $\frac{L}{H}$ as the aspect ratio, namely, ratio of wing span to wing chord. Heating and ventilating engineers also have expressed the frictional resistance of rectangular ducts to the flow of air as an aspect ratio function.

It is seen, therefore, that any attempt to derive an empirical weir formula with a constant discharge coefficient will be restricted necessarily to one specific crest length and such a formula applied by direct proportionality to any other length than the specific one on which it is based will result in error.

Machine-Spread Asphalt Meets Test

by W. W. STIFFLER

Assistant Maintenance Engineer, Oregon State Highway Department, Salem, Ore.

Square edges without headers, even surfaces without raking and a cheaper road top secured

A TRIAL SUBSTITUTION of machine spreading for the older practice of hand raking to the profile of accurately leveled side forms or headers has proved its effectiveness in producing smooth, square-edged asphalt resurfacing at reduced cost. The trial was made on the Wapinitia highway some 90 miles southeast of Portland, Ore., at an elevation of about 2,000 ft., where winter conditions are quite severe and the annual snowfall ranges from 120 to 300 in. This location was selected because at the time the experiment was planned extensive maintenance was necessary to restore the road surface to normal after an exceptionally severe spring breakup following the winter of 1935-36. The original paving on this part of the highway, placed in 1931, was an oil-mat surface 1¼ in. thick, made with a 95 + asphaltic road oil.

When plans were made to resurface a mile of this road, the work was divided into three sections of 1,760 lin. ft. each and a somewhat different method was used on each section. The purpose was to determine the possibility of obtaining a satisfactory riding profile and securing a densely compacted impervious asphaltic pavement when spread and finished by machine in courses varying in thickness from 2½ down to 1 in. compacted. The work was done under traffic (one-half width at a time) with headers and hand rakers eliminated. In all three sections Oregon's standard specifications for Class A asphaltic concrete were used, employing 5 per cent asphalt of 50-60 penetration.

Fig. 1. Placing asphaltic concrete without headers on a test section.

The same mixing and delivery methods were used on all three sections. That is, the output of two portable paving plants totaling 25 tons per hour was delivered by 1½ cu. yd. trucks directly into the hopper of a paving machine which mechanically spread the materials on a road width of 9½ ft. After being spread the materials were compacted by two 6-ton tandem rollers. Each of the three sections was constructed in two steps, half the roadway width being laid in each step. Half the roadway width for the full length of the section was completed each day, thus allowing one-way traffic, controlled by flagmen, during working hours. Normal two-way traffic prevailed at all times except during working hours.

On the first 1,760-ft. section no attempt was made to level up the existing base; as the wheel base of the paver was not long enough to correct the surface, the result was an inferior riding profile. In this section the materials were spread 3 in. deep and compacted to 2½ in. Then a layer of chips was rolled in; ¾-in. to ½-in. chips coated with 2 per cent of asphalt were spread at the rate of 5½ lb. per sq. yd. Finally, before opening the new surface to traffic, it

Fig. 2. After ten months of service, including a winter season, the surface is in good condition. Faintness of central joint line at right of traffic stripe indicates smoothness of bond.

was treated with sand, 2½ lb. per sq. yd., No. 10 to No. 200 mesh.

On section two, before any new material was placed, a day was devoted to placing 160 tons of asphaltic concrete to level up the old surface. On this better-prepared base, asphaltic concrete of class *A* was spread 2¼ in. deep and compacted to 1⅝ in. Chips, ½ in. to ¼ in., coated with 2 per cent asphalt were then spread at the rate of 5 lb. per sq. yd. and were followed with 2¼ lb. of the 10- to 200-mesh sand.

In section three, after leveling the base by methods similar to those employed in section two, the additional material was put on in two courses with the center joint staggered 6 in. The base course was compacted to 1½ in. and the top course to 1 in. This was followed with a coating of ½ to ¼ in. coated chips rolled in as before, and the surface sand treatment.

Results are favorable

In all of this work, advanced at the rate of 1,760 ft. (half width) per day, only two rakers were required to buck up and line loose materials at the edge of the pavement and at the center joint. By carefully packing and stopping the center joint all voids were filled and equal compression was obtained. The resulting line of juncture was barely visible.

In the mile of resurfaced highway a total of 1,419 tons of asphaltic concrete were used, including 287 tons used in the advance leveling treatment. The cost of this material in place was $5.61 per ton, including the rental of 35c. per ton paid on the mechanical paver.

Any announcement of results of this test was purposely withheld for a year to observe the action of the new surface under traffic, particularly in the spring when the maintenance crew is busy repairing the surface after the spring breakup. After this period of observation the quality of the surface was found to be in every way equal to asphaltic concrete placed by standard methods for work of this character such as probably would have cost, on this job, about $6.45 per ton. This figure represents the average for the total output (56,000 tons) of six portable plants engaged on maintenance in 1936.

As to comparative results of the placement methods used in the three sections, it may be said that on section one the texture of the resulting surface is inferior to that of sections two and three where ½ to ¼ in. coated chips were used. The results, based upon observation, roughometer tests, etc. conclusively prove that satisfactory results may be obtained (1) in mechanically spreading and finishing asphaltic concrete laid without the use of headers and hand rakers; (2) in resurfacing an old pavement, provided the working base is previously leveled; and (3) in the construction, under traffic, of an asphaltic concrete pavement upon a waterbound macadam subgrade or its equal.

The work described in the foregoing was carried on under the general supervision of R. H. Baldock, state highway engineer.

. . .

Progress in Sanitation In Ohio

STIMULATION of public health and sanitation activities in Ohio started three years ago with the advent of federal funds. In all, 196 sanitary projects costing $46,800,000 have been completed or are under construction. F. H. Waring, chief engineer of the State Department of Health, in his 1936 annual report summarizes the results of early promotional efforts in which engineers urged the municipalities to construct improved sanitary facilities.

Under PWA 108 waterworks improvements valued at $15,500,000 have been completed. Likewise 83 sewerage and sewage disposal plant improvements are valued at $31,300,000. Included are 55 new water systems in villages previously without water facilities, 35 new water treatment plants and 44 extensions to water systems. New sewerage systems number 13, new treatment plants 29, extensions 65. Under WPA are included 368 waterworks improvements costing $4,300,000, 842 sewerage and sewage disposal improvements costing $15,600,000, and 22 swimming pools costing $677,000. Many of these projects are self supporting, Ohio being a pioneer in charging for sewerage service.

Two other valuable public health activities prosecuted during the period are the sealing of 15,393 mine openings (64 per cent of the total) and construction of 54,337 sanitary privies (half the desired state program). The mine closures, which aim to correct the acid mine drainage problem, cost $37 each, of which 88.6 per cent is for labor, 2 per cent for materials and 9.4 per cent for supervision. The 33,337 privies built in 1936 cost $1,970,000 of which 40 per cent or $37 per unit was borne by the owner.

Steel Stresses in Concrete Pipe

by D. B. GUMENSKY and N. D. WHITMAN

Engineers, respectively, the Metropolitan Water District of Southern California and American Concrete and Steel Pipe Co.

Measuring strains on reinforcing steel in seven types of precast pipe provides a significant comparison of theoretical with actual stresses

A SERIES of tests made recently on large, reinforced concrete pipe is the first, so far as the writers know, in which the actual strains in the reinforcing steel were measured while the pipe was subjected to combined external and internal loads. Except for the fact that external loading was concentrated, conditions of the tests conformed to those under which most pressure conduits operate.

In connection with designs of large reinforced concrete pipes in the Colorado river aqueduct and in the distribution system of The Metropolitan Water District of Southern California, a theory of stress distribution had been developed which seemed to reconcile satisfactorily the various physical conditions entering the problem (*ENR*, Mar. 12, 1936). However, there still remained some doubt as to the actual value of bond between steel plate reinforcement and the concrete adjacent to it, the effective depth of pipe shell in beam action, and the effectiveness of elliptical reinforcement in resisting internal pressure.

In order that assumptions might be checked and to give some indication of the accuracy with which the designs adopted met, executives of the American Concrete and Steel Pipe Company of Los Angeles made it possible to run a series of tests in which actual measurements could be made on many types of specially constructed test pipe 60 in. in diameter. The company provided the facilities of its plant, materials and labor for the construction of the pipe, and the staff and equipment necessary for running the tests. All strain measurements were taken and the work of reducing and interpreting the results was done by the engineering staff of the Metropolitan Water District, division of design.

Although the tests were all made on pipe of the same diameter, the various sections were constructed and reinforced in different ways (see table and Fig. 2, p. 598). For type I the theory indicates that if the external load were removed while internal pressure remained unchanged, the concrete would crack on the outside at top and bottom of the pipe. This was found to be true. Type II theoretically is best suited for high internal pressures. Experimentally it was also found to resist moderate external loads quite well. Type III gives the best balanced de-

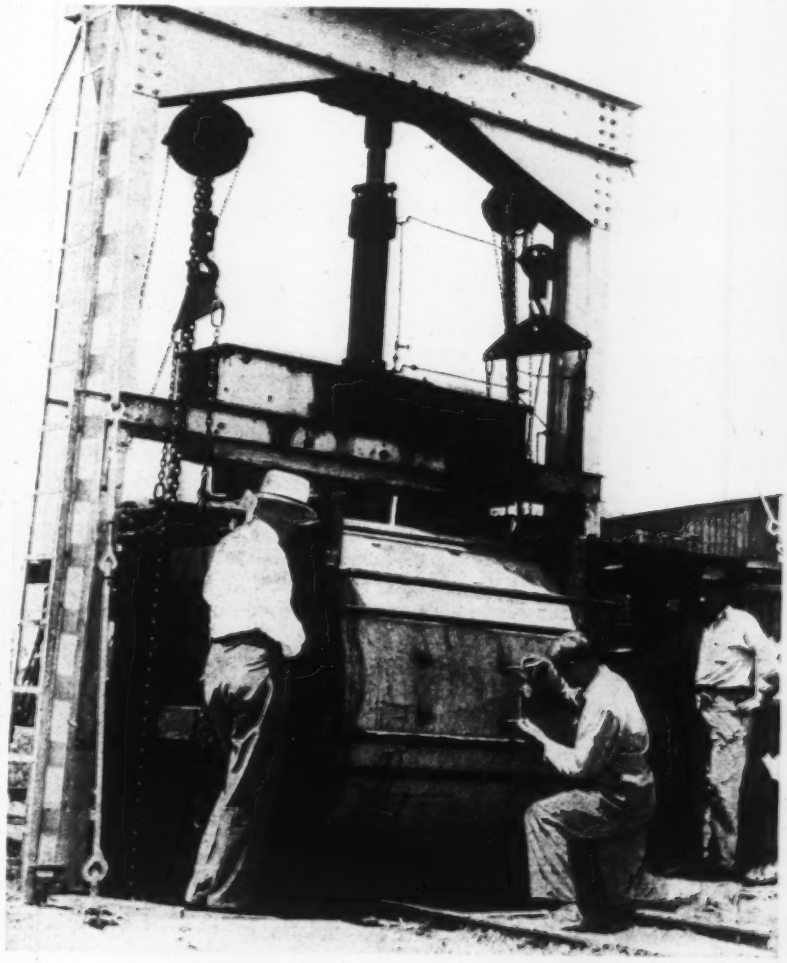


Fig. 1. Testing pipe under combined external and internal loads. Operator is making measurement of strain at springline. Note heavy bulkheads held together by horizontal tie-rods.

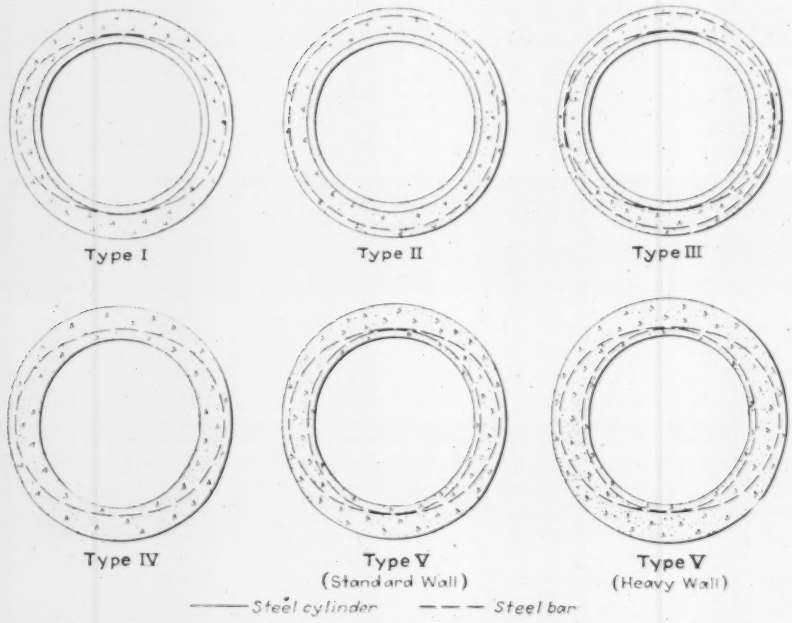


Fig. 2. Six types of pipe reinforcement were tested; three had bars as well as cylinders, three had bars only.

DETAILS OF PIPE AND REINFORCEMENT

Type		I	II	III	IV	V Standard	V Heavy
Concrete		Poured	Poured	Poured	Poured	Centrifugally spun	
Sections of pipe tested		3	3	3	1	1	1
Length of pipe section		5'-0"	5'-0"	5'-0"	5'-0"	8'-0"	8'-0"
Thickness of wall		6"	6"	6"	6"	5"	6¾"
Inside diameter		60"	60"	60"	60"	60"	60"
Thickness of mortar Lining		1 3/16"	1 3/16"	1 3/16"	None	None	None
Gage of steel cylinder		#16	#16	#16	None	None	None
Elliptical cage	No. of coils	26	None	25.5	26	38.4	38.4
	Size of bar	1/16"Φ	None	3/8"Φ	1/16"Φ	3/8"Φ	3/8"Φ
Circular cage	No. of coils	None	26	25.5	None	42.4	42.4
	Size of bar	None	3/16"Φ	3/8"Φ	None	1/4"Φ	1 1/4"Φ
Area of steel sq. in. per ft. of pipe	Cylinder	0.74	0.74	0.74	None	None	None
	Ellip. cage	0.78	.....	0.39	0.78	0.52	0.52
	Circ. cage	.....	0.78	0.39	.....	0.26	0.26
	Total	1.52	1.52	1.52	0.78	0.78	0.78

Note: 1¾" minimum cover to center of reinforcement bars.

sign under combined internal and external pressures because of the concentration of steel where it is most needed. The experiment justified this theory and proved the superiority of this type of reinforcement.

Type IV is designed to resist external loads while internal pressure is of low intensity. Type V was reinforced with inner circular and elliptical bars and the concrete in it was centrifugally spun for standard and for heavy thickness of wall. The inner circular reinforcement was provided to strengthen the pipe against internal pressure. The experiment definitely demonstrated the unusual strength and excellence of concrete in this pipe; its merits were manifest in the very small deflections and well distributed fine cracking in zones of overstress.

The reinforcing was mild steel plate and plain hot-rolled wire rods of intermediate grade. Concrete in Types I to IV, inclusive, was placed and vibrated with outside vibrators and with inside revolving rods. The maximum size of aggregate was 1 in. and 2½ bbl. of cement was used per cu. yd. of concrete. The quantity of water was not recorded, but the consistency of the mix is indicated by the Burmeister trough flow of 3.22 in. for poured and 1.00 in. for spun pipe. The average strength of concrete test samples at 28 days was 4,840 lb. per sq. in. in compression and 317 lb. per sq. in. in tension. The average modulus of elasticity, measured at 1,600 lb. per sq. in., was found to be 3.56×10^6 lb. per sq.in. In the computation $n = 9$ was used.

The pipe sections were tested in a machine with a capacity of 135,000 lb.; the pressure for the ram was developed by a 7-cylinder oil pump that could steadily maintain the desired pressures. The bulkheads were free from any bearing on the pipe while under pressure; water tightness was obtained by rubber flaps held against the pipe by the internal water pressure. The pipe was free to deflect approximately ¾ in. before coming in contact with bulkhead.

Strains in reinforcing steel were measured directly with a 10-in. Whittemore strain gage. Points of the gage were fitted into holes drilled into the reinforcement where it had been made accessible by openings in the concrete. In every series of measurements at least one reading was taken on the invar calibration bar to detect any change in a gage reading.

The measurements were usually taken in a series, i.e., by either holding the external load constant and varying the internal pressure constant and varying the external load.

Observed and theoretical stresses

The values of observed stresses in the reinforcing steel were obtained by direct measurements of strains under combinations of loadings. The strain is represented by the difference in strain gage readings for zero loading and for the actual loading under consideration. In all cases the readings for zero loadings were taken with the pipe full of water.

The unit stress in steel was obtained by applying the formula:

$$S = \frac{\Delta l}{l} E$$

where S = unit stress in lb. per sq. in.
Δl = increase, in. gage length
l = gage length in inches.
E = modulus of elasticity of steel in lb. per sq. in.

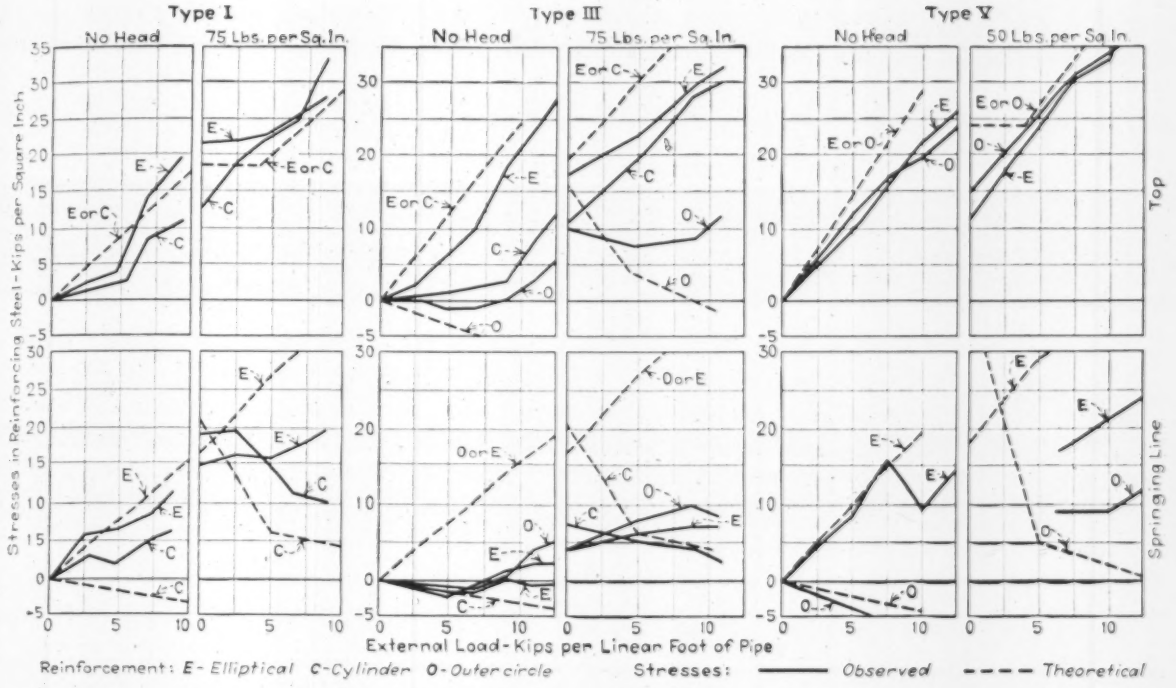

Type I
No Head
75 Lbs. per Sq. In.
Type III
No Head
75 Lbs. per Sq. In.
Type V
No Head
50 Lbs. per Sq. In.
Top
Springing Line
Stresses in Reinforcing Steel - Kips per Square Inch
External Load - Kips per Linear Foot of Pipe
Reinforcement: E - Elliptical C - Cylinder O - Outer circle
Stresses: Observed Theoretical

Fig. 3. Comparison of observed and theoretical stresses in reinforcing steel was facilitated by plotting. Note that most observed stresses are less than computed values.

The observed stresses were plotted against loads on cross-section paper, and all single readings that were obviously in error were discarded. In Fig. 3 are shown the observed and the theoretical stresses for types I, III and V.

The theoretical stresses are based on the assumptions that there is a perfect bond between the reinforcing steel and the concrete, that concrete takes no tension, and that a section, plane before bending, remains plane after bending. The values of bending moment were computed assuming the mass of pipe concentrated at its geometrical axis with external load applied at opposite ends of the vertical diameter. The internal pressure was assumed to be applied to a cylinder 62⅞ in. in diameter.

Stress checks

Inspection of Fig. 3 shows that some of the observed stresses follow quite closely the computed stresses while others fall considerably below them. Only very few stresses exceed computed values.

Since theoretical stresses in the steel were computed on the assumption that concrete is not capable of taking tension, whereas part of the tension actually is taken up by concrete, the actual stresses in steel should be somewhat below the computed values. Where bending moment is predominant in producing stress, this condition is usually obtained at the top of the pipe and in a few cases near the springing line of the pipe.

For any structural member in equilibrium, the external moment and direct force acting on it at any point must equal the resisting moment and the resultant direct stress at the same point. At the top of the pipe and in some cases at the springing line this criterion was generally satisfied for the direct stresses. The actual distribution of the stress across the section in several cases deviated from the computed distribution. This probably was due to destruction of structural integrity of the pipe through failure in bond and by cracking in the concrete surface.

Conclusions

The following conclusions have been reached by the authors as the result of analyzing data collected in this investigation:

(1) Reinforced concrete pipe of commercial dimensions may be designed by formulas for reinforced concrete members under combined bending and direct stresses.

(2) Concrete pipe reinforced with a steel cylinder remains watertight to ultimate failure.

(3) For pipes reinforced with a thin steel cylinder, the highest strength for a given amount of reinforcement is afforded by an inner cylinder, outer circular bars and elliptical bars.

(4) The bond between the steel cylinder and the concrete in the pipe fails under relatively low bending stresses. The steel cylinder has uncertain value in resisting bending, but takes its proportional part of direct tension under internal hydrostatic pressure.

(5) Concrete pipe reinforced with elliptical bars only has limited resistance against hydrostatic pressure. However, external vertical loads delay the cracking and extend to somewhat higher heads the limit of its usefulness. Under hydrostatic pressure alone the pipe fails by longitudinal cracking of the concrete on the outside of the shell along the minor axis of the steel ellipse.

(6) The strength and the action of centrifugally spun pipe is definitely superior to the pipe poured in vertical forms standing on end.

Unusual Train Wreck Fails To Dislodge Steel Truss

Pileup of ten freight cars on 150-ft. riveted span destroyed four main members and damaged others without causing a collapse of the structure

A FREAK ACCIDENT which choked a 150-ft. span through Warren riveted truss from floor to top lateral system with piled up freight cars occurred Sept. 4 at Bridgeville, Pa. on the Pittsburgh & West Virginia Railway west of Pittsburgh. Despite the terrific punishment inflicted on the double-track span, it did not collapse and is now being repaired by replacing the damaged members. In the north truss, shown on the near side of Fig. 1, only two members escaped destruction or damage. In the south truss, four web members were bent and a vertical destroyed. According to F. L. Riddle, engineer maintenance of way of the P.&W.V. Ry. Co., who supplied the accompanying information, complete collapse was probably prevented by this south truss which continued to function and, in conjunction with the floor system and the top lateral system, held up the north truss.

The wreck is attributed to a burned journal on the eighth car of a fast eastbound freight train. The defective car, loaded with steel plate, derailed west of the bridge and after passing through the structure caused the derailment of nineteen following cars. Ten of the derailed cars piled up within the truss span, and one refrigerator car passed through the side of the north truss and dropped to the bed of Chartiers Creek below. The train is said to have been traveling at a speed of from 35 to 40 miles per hour.

The bridge was originally built in 1902 by the American Bridge Co. and was designed for Coopers E-40 loading. In 1936-37 the truss was reinforced to carry the equivalent of Coopers E-65 loading. This recent reinforcing and the excellent condition of the span are believed to have been important factors in its remarkable resistance.

Truss being repaired

Immediately after the wreck the first intermediate floorbeams were shored on frame bents which permitted the wreck to be cleared by

Fig. 1. Choked with wrecked freight cars which destroyed or damaged more than half of the main truss members, this 150-ft. riveted span on the Pittsburgh & West Virginia Railroad did not collapse and is now back in service and undergoing repair while the tracks are carried on falsework.

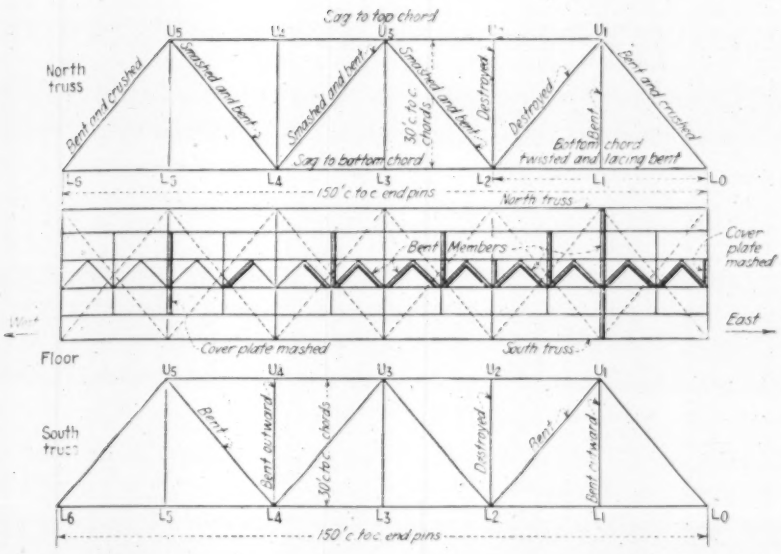


Fig. 2. **Extent of the damage to truss and floor system members of the 150-ft. span double-track P. & W. V. Ry. bridge**

cranes operating at each end of the span. All other floorbeams were then supported on pile falsework and the bridge opened to traffic.

The extent of the damage to individual members is indicated in Fig 2. Damage was greatest in the north truss adjacent to the track on which the train was running. Both end posts were smashed and bent out of line. Two verticals were destroyed and vertical U1-L was badly bent but remained connected at both top and bottom. One diagonal was destroyed and three were badly smashed and bent. The bottom chord between L0 and L2 was twisted and the lacing bent, and the top chord was out of line.

The south truss escaped such serious damage, vertical U2-L2 being the only member destroyed. Two other verticals were badly bent as were two diagonals, but these four members remained connected at top and bottom.

In the floor, the east end floorbeam and the first intermediate floorbeam were badly smashed in the top flanges. Also, numerous laterals and cross frames in the floor were bent, but all connections held. The force of the wreck tore the anchor bolts loose and moved the entire truss 4 in. from its seating.

The current repair work is being performed by the American Bridge Co. and will be completed about the end of October.

Much Deferred Construction Indicated

A LARGE "log-jam" of building construction accumulated during the depression years is seen by the *Wall Street Journal* in the first of a series of articles relating to the construction industry that begins in the Oct. 1 issue and is to be run weekly for 15 weeks. The purpose of this series of articles by Arundel Cotter of the *Journal* staff is to give the financial world a picture of the importance of the construction industry as a factor sustaining the country's prosperity.

Employment

No reliable statistics of those engaged in the construction industry are available, Mr. Cotter points out, but a government survey made in 1930 estimated that 2,800,000 individuals were engaged in building work, while a study of corporations making building materials resulted in placing the number at 3,600,000 directly engaged and 1,100,000, indirectly, a total of 4,700,000.

"Since building in 1930 was only 18 per cent of the 1926 level in money value and probably between 50 and 60 per cent in volume, and since current rate is lower than in 1930 in both respects, it is obvious that, even accepting the lower figure for 1930 building labor, a return to the 1926-29 levels of building activity should greatly reduce our unemployed brigade, going far toward solving our idle worker problem."

Postponing a Factor

"One of the principal difficulties that beset the path of him who attempts to estimate the building picture and outlook is the highly postponable nature of the industry. Buildings last a very long time, even if lacking in modern essentials, while the economic life of the majority of products is limited. Food, of course, is highly perishable and must be produced constantly, hence the comparatively light fluctuations between the highs and lows of the food cycle. The economic life of an automobile is estimated around eight years, although it may serve its purposes a good deal longer. A house or an office building may be used 100 years or more. Even an industrial plant, although really obsolescent as a result of improvements in manufacturing methods, will in many cases serve its purpose for prolonged periods.

Important to Investor

"Because of the impact of building upon all other industry, particularly on money, railroading, steel, lumber, cement, furniture, paint products, to mention some of the most obvious, the signs and portents of the building situation appear more important for observation by the investor or would-be investor than any other signs in the business horizon. And it may be said that despite certain clouds that have yet to be cleared up, these signs and portents in the building picture appear at the moment to afford groundwork for optimism. The statistics available lead to the conclusion that the next five or six years should witness a decided, if at times irregular, increase in building activity which, in turn, will react favorably on other departments of our economic life and prove beneficial and profitable to holders of securities."

Waterworks Men Meet in Maine

Convention of the New England Water Works Association features technical sessions on corrosion control and gravel-packed wells

POLAND SPRING SPA, with its world-famous reputation for fine water, was the inspirational setting of the 56th annual convention of the New England Water Works Association, Sept. 21–24. Registration at the four day meeting included 557 members and guests, and the exhibits by manufacturers numbered 53. Featured on the technical program was a symposium on pipe corrosion problems and prevention and discussions of gravel-packed wells. Other papers dealt with improved treatment technique, licensing legislation, spillway model tests, and watershed protection.

A news account of the convention including the new officers was published in last week's issue, p. 529.

Control of corrosion

The importance of corrosion control as one of our major engineering problems was emphasized in a symposium conducted by Frank N. Speller, director of metallurgy and research, National Tube Co., Pittsburgh. At one time it was thought that corrosion troubles could be ended by the development of a suitable metal. Experience has demonstrated, however, that there is no one metal, coating or type of treatment that will prove effective in every case.

Metals, said Dr. Speller, are essentially unstable and tend to revert to their compounds. It has been observed that nature creates protective films which restrain this action, and studies of these natural films have been useful in alloy steel development. This has led to the use of chromium, copper, nickel and other alloy elements.

Corrosion may result from chemical action (oxidation) or electrochemical phenomena such as occurs in water and soil. In connection with piping, it is the latter with which the waterworks engineer is principally concerned. Protective measures may be instituted by (1) improving the resistance of metals through the use of alloys; (2) applying artificial coatings on pipes; and (3) by proper treatment of soil and water environment. Illustrative of the latter, mention was made of compacting trench backfill around pipes; unless this is done carefully so that the soil structure is homogeneous, oxygen may reach some points on the pipe faster than others with resulting corrosive action.

Experiences with corrosive water at Cambridge, Mass. were related by M. C. Whipple, assistant professor of sanitary chemistry, Harvard Engineering School. The water at this place comes from a surface supply, is soft, contains about 7 p.p.m. carbon dioxide, and has a pH of 6.6. In 1923 when a filter plant was first placed in operation, no corrective treatment was provided and in six months time corrosion was noted on iron, copper and brass piping, and redwater trouble developed.

The application of soda ash lowered the carbon dioxide content and reduced redwater conditions but corrosion continued at a rapid rate. Finally, lime treatment was employed, bringing the water to pH 8.3. This lessened discharge of rust in iron pipe and there has since been reduced corrosion and failure of iron and brass pipes. Copper pipe (composition, 85 per cent copper and 15 per cent zinc) has thus far proved the most resistant material for present Cambridge conditions.

Contact of water with metal always produces some chemical action, said Robert Spurr Weston, consulting engineer, Boston, and what happens after this will result either in corrosion or the formation of a protective film. When pH values are low, lime or

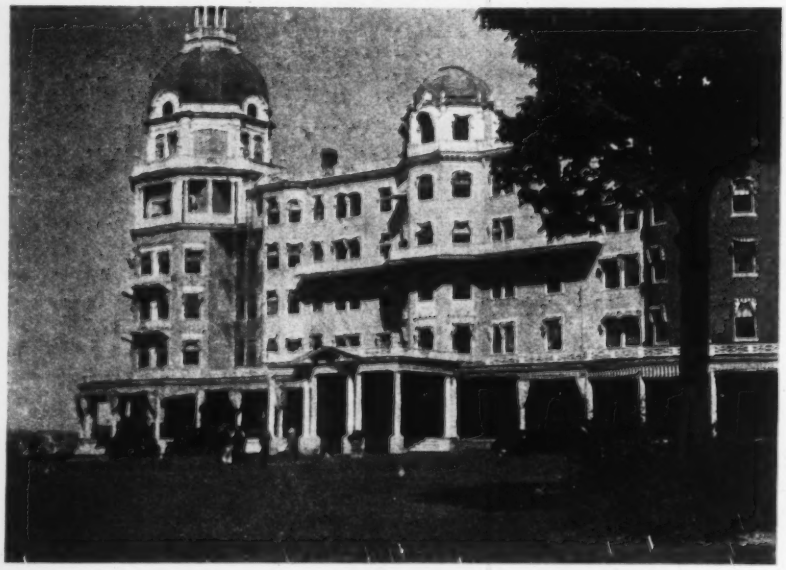


Fig. 1. Poland Spring House, the convention headquarters; good weather and the golf course competed for attention with the technical sessions inside.

sodium compounds are added to restore chemical balance. Lime is most commonly used to reduce the carbon dioxide content but the equilibrium established is good for only a single temperature condition. Because temperatures will vary from time to time, the neutralization zone must be extended over wide limits.

Mr. Weston reported that in Germany the use of a magno-double salt for neutralization was proving successful, and might be found useful here in lieu of marble dust. The German material is prepared by roasting dolomite which forms a double salt compound of magnesium oxide and calcium carbonate. It absorbs twice as much of the carbon dioxide as does marble dust. The cost of treatment per million gallons for removing 20 p.p.m. of carbon dioxide would be about $5. For neutralizing 20 p.p.m. with soda ash and hydrated lime the cost would be $8.30 and $4.15 per million gallons, respectively.

Discussing the effect of dissolved oxygen on the corrosive action of water, F. Wellington Gilcreas, associate sanitary chemist, New York State Department of Health, reported data obtained in a comparative study of three typical public supplies on Long Island. In all cases, the water came from wells, was quite soft, and low in pH value (5.1 to 5.7). Two of the supplies, containing 19 and 30 p.p.m. of carbon dioxide, respectively, were aerated on the principle that reduction of dissolved gas would eliminate occurrence of redwater; the third supply, containing 26 p.p.m. carbon dioxide, was not aerated, and it contained a low (0.3 p.p.m.) dissolved oxygen content.

With all these supplies, no serious redwater or similar unsatisfactory condition in dead ends were reported. Since brass and copper are not extensively used in this area, there was no data on the possible effect of these waters on non-ferrous metals.

Spun bituminous lining

The present state of development in the application of protective coatings to pipe has "eliminated the bugaboo of soil corrosion" which at one time cost owners of underground pipe a loss of $1,000,000 annually, said George E. Boyd, district manager, Wailes-Dove-Hermiston Corp., New York. In tracing the history of this development, he pointed out that oil and gas line operators pioneered in research leading to the improved materials, new methods and mechanical equipment used for spun lining.

Present knowledge of soil corrosion protective coating indicates that (1) cold coatings such as paints, emulsions and inhibitors are worthless for prevention of underground corrosion; that greases do not prevent corrosion but do somewhat reduce pitting; and (2) coal tar enamels (coal tar containing inert materials) are the best type of protection yet found, and are generally better than asphalt because of their resistance to moisture absorption.

In applying coatings to pipe it has been learned that the metal structure and surface have much to do with good adhesion.

British practice in pipe lining differs from that in this country, according to a paper by J. Mitchell, director of research and development, Stewarts & Lloyds, Ltd., London, in that petroleum asphalt coatings are preferred to coal tar. The latter, first used for dip coatings, were not found satisfactory.

Good adhesion is important in spun linings and this is achieved by (1) applying the coating to a clean metallic surface and (2) by "wetting" the pipe with warm bituminous material before the lining is spun. Observing these precautions makes it possible to secure a bond of 500 lb. per sq.in. at the interface, a value which is three times greater than the tensile strength of the material itself.

Economics of water treatment

An apraisal of the economic value of water purification was presented by Arthur L. Shaw and E. Sherman Chase, Metcalf & Eddy, consulting engineers, Boston, who set forth a dollars and cents estimate of quality improvement. Few waters, it was said, can qualify as possessing all the desirable characteristics associated with the term "pure water." Therefore, treatment of some kind must be given; the question to be answered in every case is how much benefit is derived from such treatment?

Taking first treatment designed for the removal of disease bacteria, it was reported on the basis of damage claims resulting from an outbreak of typhoid fever in Olean, N. Y., that the economic value of safe water is equal to $30,000 per year per million gallon supplied.

The financial value of satisfactory physical and chemical quality was based on the comparative usage of bottled spring water in places having good and objectionable public water supplies. This was said to range from $2,000 to $20,000 per year per million gallons daily consumption, a figure which represents the economically justified expenditures in annual charges for purification. The removal of color and turbidity, for instance, was estimated at $200 per p.p.m. over 10, and $400 per p.p.m. over 5, respectively. Reduction in hardness was valued at $150 per p.p.m. over 100, and iron and manganese at $1,000 per p.p.m. A more complete abstract of this paper will be published in an early issue of *ENR*.

Gravel-packed wells

In a symposium on gravel-packed wells led by Paul Howard, of Whitman & Howard, consulting engineers, Boston, recent installations and operating experiences with such wells in Massachusetts were described.

In Attleboro, three 52-in. low velocity wells were constructed to replace 88 2½ in. wells in order to obtain water low in iron content. The 2½-in. wells, some of which were installed in 1925, drew water at high velocities; iron content increased from an initial 0.15 p.p.m. to 1.94 p.p.m. over the course of several years. It was believed, said Mr. Howard, that the high velocities exhausted the oxygen of the water and this caused the iron to be taken into solution.

To remedy the situation, the top soil (containing iron) over the well field was removed, and low velocity gravel-packed wells, 52 in. in diameter and 22 ft. deep, were installed. Operating tests have shown that with a pumping rate of 100 g.p.m. (three wells) the iron content averaged only 0.2 p.p.m. initially and has now dropped to 0.13 p.p.m. Although the surrounding area contains much iron oxide, it is believed that the low velocity pumping maintains the oxygen content in the water and this prevents the iron from going into solution.

The importance of thorough tests

to insure proper selection of a well site was stressed by Bayard F. Snow, president, X. Henry Goodnough, Inc., engineers, Boston, who described the installation of the Needham gravel-packed well. In this region groundwater supplies are obtained from a relatively small area one mile wide and two miles long.

Observation wells were driven in a number of places, one of which gave a very poor yield. Careful study of drawdown curves under various rates of pumping finally established the limits of area best suited. In this way actual location of the proposed well was confined to an area within a 100-foot square.

Details of two gravel-packed wells at Woburn, Mass. were given by John E. Wentworth, Metcalf & Eddy, Boston. One of these, 40 ft. deep, has an outer diameter of 4½ ft. and an inner casing of 24 in. in diameter. The upper portion of the outer diameter, to a depth of 21 ft., is provided with a concrete seal. The other well is 80 ft. deep.

Shutter type screens coated with porcelain enamel are used. Turbine pumps, one of 7- and the other of 8-stages, are used and they are provided with four speeds to vary pumping capacities.

Coagulation with iron compounds

Operating experiences with iron coagulants under various conditions were reported by Malcolm Pirnie, consulting engineer, New York, who stated that ferric salts are a valuable addition to water purification practice. Studies at two plants treating water containing ferrous carbonates demonstrated that intimate contact of this salt with previously precipitated ferric hydroxide on the gravel surfaces of the filters removed iron; in one case the iron content was reduced from 7 to 0.1 p.p.m.

At Providence, R. I., where the treatment of soft colored water containing iron and manganese caused redwater trouble and manganese deposition, successful use of four iron coagulants was developed.

For partial softening of the hard water low in sulphate, Mr. Pirnie described the use of anhydrous ferric sulphate at the Pinellas Water Co. plant in Florida (*ENR*, Sept. 15, 1937, p. 461). Here the iron salt is added to a portion of raw water to augment the free carbon dioxide of the well water by that released from the reaction with the bicarbonate contained in it to effect recarbonation of the soft water.

Other cases in which iron coagulants proved effective included a highly colored swamp water where not only was color removed but the silica content reduced as well; a colored soft water containing no manganese; acid-mine waste water; and pretreatment of a small impounded soft water supply.

Filter sand bed expansion

Use of a recording device for measuring and indicating degree of per cent of sand expansion in backwashing filter beds was described in a paper by H. J. Krum, city chemist, Allentown, Pa., and Everett M. Jones, Simplex Valve & Meter Co., Philadelphia. The device consists of a cone-shaped float, a counterweight and an indicating dial calibrated to read per cent of expansion. The float rests on the surface of the sand bed, and through proper balance of a counterweight it rises with the sand when backwashing occurs. Its construction is based on the description of a sand expansion indicator published by Hulbert & Herring in the *Journal* A.W.W.A., Vol. 21, No. 11, 1929.

Numerous studies on a model filter demonstrated that the meter is accurate and stable irrespective of the particle size of the filter medium, temperature and depth of sand bed. By means of the meter, it was said, the process of filter washing by a group of operators can be standardized. This not only leads to increased operating efficiency but savings in wash-water as well.

Spillway model tests

An investment of $5,000 in model tests leading to the design of a spillway for the Bills Brook Dam of the Metropolitan District of Hartford County, Conn., resulted in a saving of $35,000, said William Dorenbaum, designing engineer for the district, who described the method of making the tests.

Design work was carried out in the office in the usual manner and later checked on a one-thirtieth scale model erected at the Alden hydraulic laboratory of the Worcester Polytechnic Institute. Principal objectives of the test were to study the hydraulic features of the weir and channel, the matter of erosion at the discharge, and waterway capacities of two bridges across the dam top and spillway channel.

Among the changes that were made in the original design was the raising of the spillway bridge 2 ft. and lowering of the channel depth 2 ft. in order to accommodate maximum flow without obstruction. Also changed were the steep side slopes of the transition section of the spillway channel to reduce a jetting effect of the central stream at high velocity. The observance of high velocities which might lead to the creation of considerable "white water" (water filled with entrained air) suggested the use of extra freeboard along the channel slopes.

New accounting system

Highlights of the new uniform accounting system for water utilities in Maine, applying to private as well as public purveyors, were discussed in a paper by Allan F. McAlary, treasurer, Camden and Rockland Water Co. The new system which goes into effect on Jan. 1, 1938, is the first major revision in accounting practice since 1915, and has been designed to provide more detailed information, especially in revenue income classifications. Basic bookkeeping procedures have not been changed but their scope has been widened to include additional data.

Under the new regulations, utilities are divided into three classes, depending on revenues. In group A are those with an income of more than $50,000, group B includes those in the $10,000–$50,000 class, and group C includes those receiving less than $10,000. By means of this division it is possible to limit the amount of bookkeeping work for small companies but at the same time provide for more complete breakdown of data in the case of larger companies.

Submarine pipe laying

The difficulties involved in laying a 16 in. cast-iron submarine water pipe across the Kennebec River were described by S. S. Anthony, engineer and superintendent, Augusta water district. The job, on which a con-

tract bid of $38,000 was received, was carried out by the district forces instead, and due to a series of cofferdam mishaps the final cost came to $85,000. The troubles which raised the cost were due to high water and ice which flooded and overturned the structures.

The pipe line, composed of 6-ft. lengths with universal bolt joint connections, was laid in an average water depth of 22 ft., and the submerged portion was 640 ft. in length. Timber crib cofferdams were used to dig a trench 4 to 6 ft. deep at the river bottom. The pipe was laid on a mat of fine gravel in this trench which was backfilled with gravel, a layer of concrete, a layer of paving stone.

Fig. 2. Manufacturers' exhibits lined along the sunny porch of the hotel were strategically placed to invite attention.

Watershed and recreation

The solution to the problem of watershed contamination by campers and other persons seeking recreation in areas adjacent to water supply properties is the construction of suitable facilities where activities can be supervised, according to David G. Moulton, attorney of the Portland (Me.) water district, who outlined a development of the Outer Pond recreational area at Lake Sebago. The latter serves as a supply for Portland and other communities served by the district.

Lake Sebago covers an area of about 47 square miles, is 300 ft. deep in some places and has so great a storage capacity that it would take 8 years to run dry if no input occurred. The water has been potable at all times since the first sanitary survey made in 1907 and elaborate precautions have been taken by the district to maintain the high quality of this supply. Within a two mile radius of the intake, more than 98 per cent of the land has been purchased by the district at a cost of $330,000, and access to the shoreline is denied.

In order to meet the popular demand for recreational facilities in the lower end of the lake where the intake is located, a group of small ponds bordering Sebago, but at a lower level, were purchased by the district with the aid of federal emergency funds. The area around these ponds is being converted into picnic grounds, beaches, playing fields, parking spaces and trailer camps. Thus far $40,000 WPA money and $4,000 from the district has been put into this project.

Operator licensing

Present-day demands for high quality water and consequent need of skilled plant operation make it desirable for adequate legislation to provide for the qualification and licensing of water treatment plant operators, said Warren J. Scott, director, Bureau of Sanitary Engineering, Connecticut State Department of Health, and newly elected president of the N.E.W.W.A. He reported that a country-wide canvass revealed lack of suitable legislation in 40 states.

Broadly analyzing the state laws already passed, he stated that these fell into two categories, namely: (1) those which provided for a definite licensing plan in which only persons possessing a license would be selected for operating a plant; and (2) those which provide for qualification only. Under the latter plan, a man selected for plant operator by a municipality applies for qualification to the state board; if his application is approved he is eligible for the position.

The construction and installation of high pressure reinforced concrete pipe was the subject of an illustrated talk by F. F. Longley, vice-president, Lock Joint Pipe Company, Ampere, N. J. With the aid of motion pictures the audience was taken to Little Rock, Ark. to see the installation of a 39-in. diameter, 163,000-ft. long, concrete water supply line. The pipe consisting of a steel cylinder surrounded by a reinforced concrete shell, was built to withstand a hydraulic head of 400 ft. in some places.

The installation of dual water mains and fire hydrant connections was discussed in a paper by Arthur F. Ballou, engineer, National Board of Fire Underwriters, New York, who pointed out that the single main system is being abandoned in some places because of the high cost of pavement cutting.

Water meter perfection

Pointing out that the present day water meter with its relatively high accuracy, sturdy construction and low cost has reached a high state of perfection, Walter Parker, department manager, Pittsburgh Equitable Meter Co., Pittsburgh, stated that improvements might now be made by use of metal alloys and plastics.

The closing session of the meeting was devoted to a superintendents round-table discussion led by Harold L. Brigham, superintendent, Marlborough (Mass.) Water and Sewage Commission, and a chemists round-table discussion led by Stuart E. Coburn, Metcalf & Eddy, Boston.

Tolerances and Reinforcing For Tilted Cylindrical Piers

by Robert H. Chambers,
New York, N. Y.

Three cases in New York City vary widely in treatment of out-of-plumb deep caissons

Three recent cases of deep cylindrical pier foundation construction in New York City indicate a decided difference of opinion among the designing engineers as to permissable deviation of the cylinders from true position and true plumb. Furthermore, there is an equally divided opinion as to the method of reinforcing such piers that exceed the allowable tolerances for position and deviation from the vertical. From personal experience with the contractor on these three jobs the writer contends that in all three cases the tolerance specifications were at fault and the method of reinforcing those piers that exceeded the specified tolerances was not correct.

Varying tolerance specifications

The specifications for the foundations of the downtown federal office building in New York, built in 1935, contained the following clause relating to cylindrical foundation piers:

> "The center of each caisson shall not vary from its designed center by more than the distance which increases its designed stress by ten per cent. Its center at any other horizontal plane shall not be out of plumb from the center of its top by more than one-sixtieth of the depth of such plane."

Plans and specifications for this job were prepared by the Treasury Department of federal government.

A similar clause in the specifications for the section of the West Side elevated highway from 46th to 59th Sts., Manhattan, prepared by the Highway Bureau of the city, allowed a deviation of 2 in. from position at the top of the cylinder and a deviation from vertical alignment of one one-hundredth of the depth. Still another set of tolerances was specified for similar piers on the section of Riverside Park improvement from 135th to 146th Sts. by the New York Central RR., where the plans permitted a shift of 3 in. from position at the top and a deviation from plumb of one-hundredth of the depth.

All three of these structures were founded upon piers of the same design, performing the same function. Then why is there a difference in the tolerances specified? Further, there is a fallacy in the specifications themselves.

Let us assume that a pier 60 ft. in depth is out of position at the top in a southwest direction by 2 in.; assume that its deviation from plumb is 7 in., also in a southwest direction. The resulting eccentricity—the horizontal distance from the column center to the center of the pier at the bottom—is then 9 in. But what if the deviation from plumb had been in a northeast direction? The eccentricity would then be only 5 in.

Now suppose that the depth of the pier was 90 ft. instead of 60 ft., and that the slope of the pier remains the same. The eccentricities are now 12½ in. and 8½ in. for the two directions, respectively. We therefore conclude that specifying the deviation at the top separately from the plumb tolerance is incorrect, and that it is not the slope of the pier that should be constructed but the total deviation from vertical alignment regardless of the depth.

The stress used in designing the concrete piers for the federal office building was 800 lb. per sq. in. An increase of 10 per cent makes this allowable stress 880 lb. per sq. in., an increment too small to be consistent with the factors of safety that must have been used. It would have been better to have used a smaller stress in the design and then to have allowed a larger increase due to deviations. In a pier 5 ft. in diameter an eccentricity of only 3 in. would increase the stress from 800 to 880 lb. per sq. in.

Reinforcing contradictory

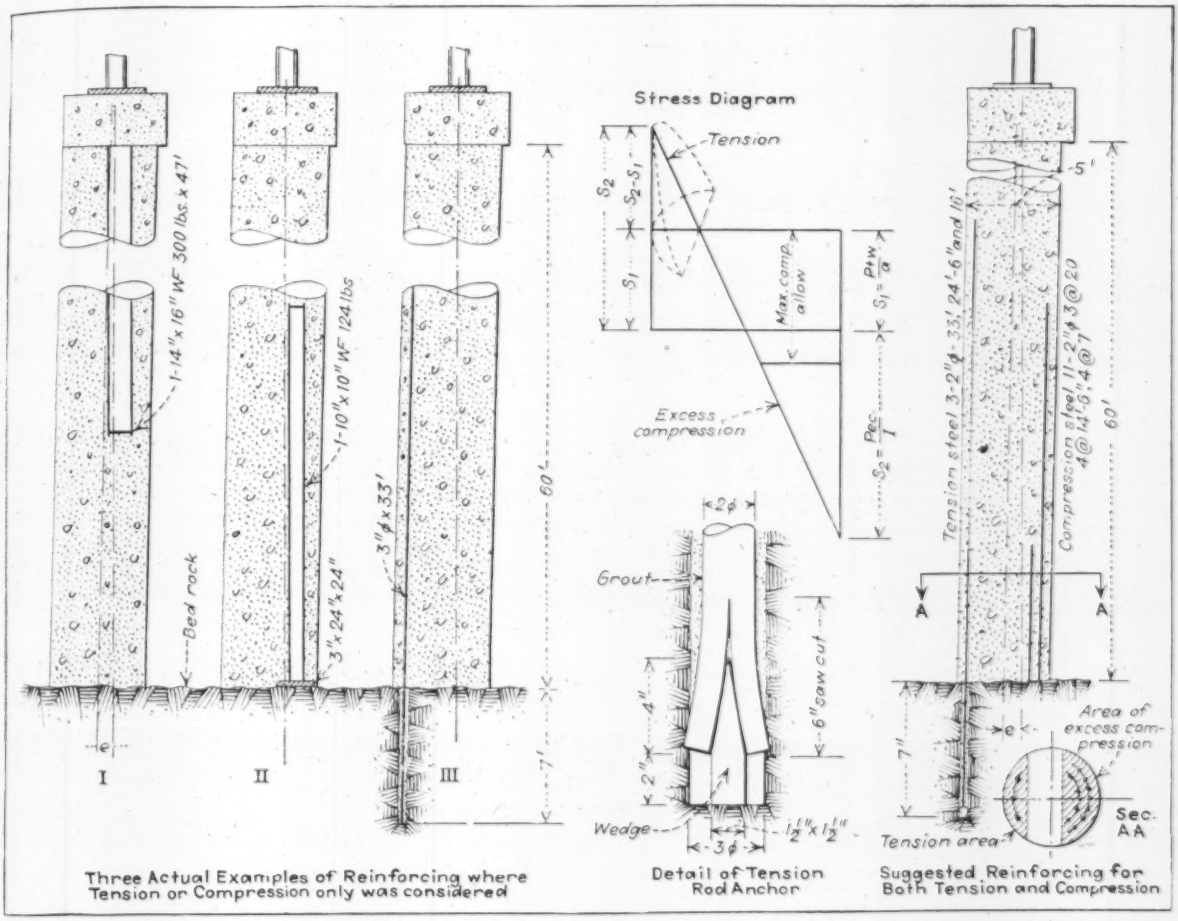
In the three cases referred to, the reinforcing employed where the tolerance limits were exceeded varies in each case, and furthermore, the methods are contradictory. The reinforcing is shown at the left of the accompanying sketch. Type I is on the federal office building; Type II is on the elevated highway; and Type III is on the New York Central job. A stress diagram of the piers is shown in the center of the sketch. Note that in the first and second types the reinforcement steel is found only on the side of excessive compressive stresses and none on the tension side; on the third type there is no steel for compression but the tension side is reinforced.

Which type is correct? The writer believes that none of them is right. Two designs account for compression but neglect the high tensile stresses occurring at the bottom of the pier; the third neglects the compressive stresses but adequately accounts for the tension. Obviously, as both tension and excessive compression are present in an eccentric pier, both must be provided for. A suggested method of reinforcing is shown at the right of the sketch.

Proposed specifications

The following specifications are proposed as providing a satisfactory foundation pier:

> The eccentricity of the cylindrical piers caused by deviations from position and vertical alignment shall not be greater than an amount that produces tensile stress in the concrete, nor shall the deviation at the top from the designed center be more than one-eighth the diameter of the pier. Should a greater eccentricity occur the pier shall be reinforced to adequately account for the excess stress.



Three examples (left) of reinforcing out-of-plumb deep cylindrical caissons, regarded as inadequate to resist excessive stresses in the concrete, and a proposed method of reinforcing (right). A stress diagram of the piers to the left is shown in the center sketch. The expanded rod bottom anchor is a suggested additional factor of safety.

The sketch shows a proposed method of reinforcing that provides for both compression and tension. Because of the difficulty of installation of the tensile steel careful inspection should be made to insure a good and adequate bond of the rods to the rock. A sure method of anchoring the steel is also sketched.

Following is a brief resume of the method of designing the reinforcement. Assumed conditions are:

Diameter of pier, 5 ft.

Depth of pier, 60 ft.

Column load, 1,700,000 lb.

Max. compressive stress in the concrete, 900 lb. per sq. in.

Deviation from position at top, 2 in. north, 2 in. west.

Deviation from plumb at top, 16 in. south, 12 in. east.

The direct stress due to the column load and the weight of the pier is $S = \frac{P + W}{a}$. The stress due to the eccentricity is $S_2 = \frac{Pec}{I}$ where P is the column load in lb., W is the weight of the pier in lb., a is the area of the pier in sq. in., e is the eccentricity in inches, and $\frac{I}{c}$ is the section modulus of the cylinder. The stress of compression is therefore $S_1 + S_2$. The tensile stress is $S_2 - S_1$.

If the stresses shown in the center section of the accompanying sketch are the unit stresses, the volumes, of which the parts of the diagrams are the projections, will be the total stresses. Therefore, find the volume of the ungulas to determine the amount of excess stress that must be accounted for by the addition of reinforcing steel. The stresses diminish toward the top as the eccentricity diminishes. Therefore, it is not necessary to carry all of the steel up to the same level or to supply any at the top.

To find the point where the tensile stress disappears, in $\frac{Pe'c}{I} = S_1$ solve for e' and find, by proportional triangles at what elevation this eccentricity occurs. Similarly if S_3 is the maximum allowable compressive stress in $\frac{Pe''c}{I} = S_3$ solve for e'' and determine its elevation. The compressive steel need not extend above this point. The depth into the rock that the tension bars should be placed will depend upon the bond strength of the bars and grout. The expanded bottom of rod shown in the sketch is an additional factor of safety, but no allowance should be made for its strength because of impossibility of inspection and determination of the effectiveness of this wedged anchor.

Air Conditioning Demands On Water and Sewage Facilities

Air conditioning installations have increased nearly 1,400 per cent since 1933

THE NUMBER of air conditioning installations in the United States has increased approximately 1,400 per cent since 1933, and since slightly less than half of all installations depend upon local water supplies for their cooling and conditioning agent, the question of water available for such use becomes an extremely serious one. Equally serious is the problem of the disposal of used water. The result of this heavy discharge of additional water into the sewerage system of a community places so great a burden on the facilities that it has become necessary to place limitations on the further installation of air conditioning plants either in the community as a whole or in certain particular sections of a city. A report on the effect of city water and sewerage facilities on the market for air conditioning equipment (Market Research Series No. 16) prepared by the U. S. Department of Commerce provides this information along with statistics received from 91 of the 94 cities with a population of 100,000 or more.

Inadequate facilities

In cities where water demand by air conditioning equipment is a growing factor, the existence of large reserve supplies of water does not necessarily indicate that the authorities will be able to furnish unlimited service, states the report. Thus, Atlanta, Ga., with a reserve supply of more than 1,600 gal. per capita and an apparent safe yield of more than half that amount, has a daily delivery capacity of only 150 gal. per capita. Furthermore, in this particular city, there is no present possibility of increasing delivery until additional treatment facilities have been built.

The situation in the Chicago Loop district was cited as another case of limitation due to inadequate equipment. Chicago has almost unlimited pumping capacity, yet with only about 16 per cent of the Loop district air conditioned the maximum pumpage on July 26, 1936, was at a rate of 65 m.g.d. On this particular day, and on a number of other days during the summer of 1936, the air conditioning waste water discharged into the sewers created a great deal of trouble, since the sewerage system built in 1856 was unable to accommodate the extra flow, and many basements in the area were flooded. Loran B. Gayton, city engineer of Chicago, was quoted as estimating a potential need of 295 m.g.d. of water if the entire Loop area is equipped for air conditioning. The present delivery capacity of the city water system in this district is about 240 m.g.d.; until the sewer system is rebuilt, however, no additional water-using air-conditioning plants may be installed in this area unless they are equipped with cooling towers.

It was also stated that city water authorities in planning to meet increasing demands for water for air conditioning or other purposes will find that every factor affecting their delivery capacity must be given due weight. Otherwise they may find themselves in the situation of one of the leading American cities which has a vastly greater reserve pumping capacity than it can expect to use for many years, but which can meet only a very minor increase in demand for water because the purification plant and distribution system are not in proportion to pumping capacity.

Changes in water demand

In a table showing the actual annual delivery of water in gallons, by cities, the percentage of annual change by years is also included. This shows that in the years from 1931 through 1934 the majority of cities had one or more years in which demand for water showed decreases of many millions of gallons. This was attributed to the lack of industrial and commercial demand for water growing out of the depression conditions of those years.

In 1935 there was a reasonably constant increase in water demand over 1934, while in 1936 all but six cities of the 91 reporting showed increases over the 1935 demand. The increases ranged from 0.7 per cent in El Paso, Texas, to 32.6 per cent in Cincinnati, Ohio. Thirty-nine cities reported an increased demand of more than 10 per cent in 1936 over 1935, one city reported no change, and five reported decreases.

Outlet water temperatures

The temperature of water at the main outlet and the normal mean temperatures for selected months has also been tabulated. One of the important facts developed by these temperature comparisons, points out the report, is the reversal in position of air and water temperatures in August and September. In general, from April through July, water temperatures are below normal mean air temperatures, but in practically every city this situation is reversed during August and September, the water temperatures at main outlets running as much as 16 degrees higher than the air temperature. This condition is said to indicate that the use of water in air conditioning installations in the late summer will increase by a considerable amount over usage during the earlier months of the summer unless steps are taken for conservation either through the use of partly refrigerated water or some other method for offsetting the higher water temperature.

In commenting on the need for more detailed information concerning the operation of water-using air conditioning installations, the report emphasized the necessity for city water authorities of each community to make a complete census of air conditioning equipment which they are serving. This survey should include data on the installed horsepower, the tonnage of refrigeration supplied by each installation, the water required, as well as the method of disposing of the waste water from the air conditioning installation.

FROM FIELD AND OFFICE

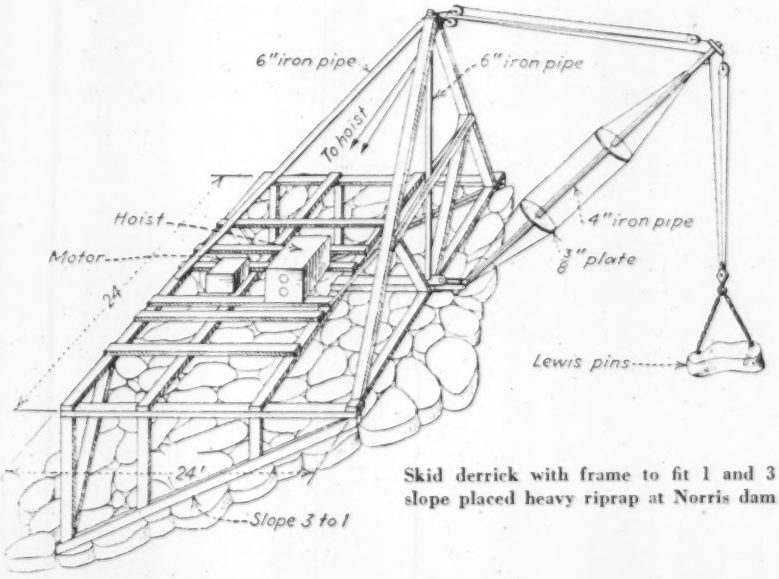
Working problems and time-saving methods . . . Edited by Charles S. Hill

Derrick for Riprapping Slopes

The derrick illustrated here was built on the job for placing 32,200 sq.ft. of riprap at Norris Dam on a 1 on 3 slope over a rolled fill. It consists of a 4-in. pipe boom reinforced with four ¾-in. rods, mounted on a timber skid frame with unequal legs. A double drum hoist for handling boom and load lines was adapted from an old tractor hoist, powered by a 10-hp. electric motor, direct connected. The boom, mounted on a swivel joint was swung by tag lines.

The derrick was moved about on the slope by a hoist-equipped tractor, by its own power or by the cableway at the dam. Rocks varying from ½ cu.ft. to 2 cu.yd. were placed; those ¼ cu.yd. or less in size were drilled with one Lewis-pin hole and larger rocks were drilled with two holes and handled with two pins. Stones about 2 cu.yd. in volume were slid into place one end at a time.

Worked on an average of 18 hr. per day, the average daily output of the rig was 400 sq.ft. of riprap, amounting to 800 cu.ft. of stone or about 50 tons. The operating crew included a foreman, five laborers and a derrick operator. It is suggested that similar rigs in the future have the bottom timbers faced with steel plates to prevent excessive wood abrasion.



Skid derrick with frame to fit 1 and 3 slope placed heavy riprap at Norris dam

. . .

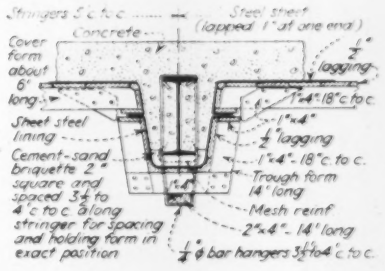
An Early Hung Form For Concrete Floors

by E. E. HOWARD

Ash-Howard-Needles & Tammen, Kansas City, Mo.

The ingenious hung form for concrete floor construction described by K. B. Humphrey (*ENR*, July 1, p. 34) calls to mind the hung forms which proved most advantageous installation, removal and reuse in building the Sixth St. Viaduct at Kansas City, Mo. The sketch indicates the construction which was described in detail in *Transactions* Am. Soc. C. E., Vol. LXV, p. 81.

The ¼ in. round-bar hangers were very efficient and needed only to be bent around the top flange of the stringer with a hammer to provide all the support needed. An interesting recollection survives of the substantial character of the cover forms made with 1 x 4-in frames, and ½-in. lagging covered with light sheet steel. The workmen soon found in removing these forms that they could be given a twisting throw and would sail to the ground and fall flat, undamaged, from heights as great as 60 ft. They were handled this way for repeated usages on many construction jobs.

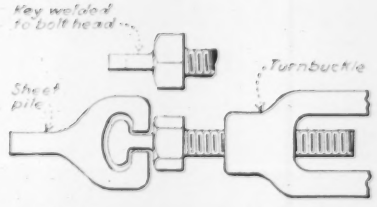

Stringers 5' c. to c.
Steel sheet (lapped 1" at one end)
Concrete
Cover form about 6' long
2" lagging
1"x4"-18" c. to c.
Sheet steel lining
1"x4"
½" lagging
Cement-sand briquette 2" square and spaced 3½ to 4' c. to c. along stringer for spacing and holding form in exact position
1"x4"-18" c. to c.
Trough form 14' long
Mesh reinf.
2"x4"-14' long
½" ϕ bar hangers 3½ to 4' c. to c.

Hung forms used 30 years ago on Sixth St. Viaduct, Kansas City, Mo.

. . .

Device for Threading Steel Sheet Piles

Difficulties of threading the final pile in a circular cell, or wherever a closure had to be made, were greatly reduced by the use, at Grand Coulee Dam, of a device consisting essentially of a turnbuckle with special heads on its bolts to fit in the adjacent sheetpile grooves. As shown in the sketch, a projection flattened in one direction to permit it to slip into the groove in the pile was welded to the bolt head. This projection can be inserted at any point in the groove by slipping it through the slot and then giving it a half turn to enable it to bear against the pile fingers. When both bolt heads are in place the turnbuckle is tightened until the exact spacing desired is obtained. By operating the turnbuckle in the opposite direction



Turnbuckle device for spacing steel sheet piling.

so the bolts are put in compression the spacing between the grooves can be increased. After the new pile has been threaded the turnbuckle device is removed before driving begins. This device was developed by H. L. Schlubach, field engineer, Mason, Walsh, Atkinson and Kier Company, Mason City, Wash.

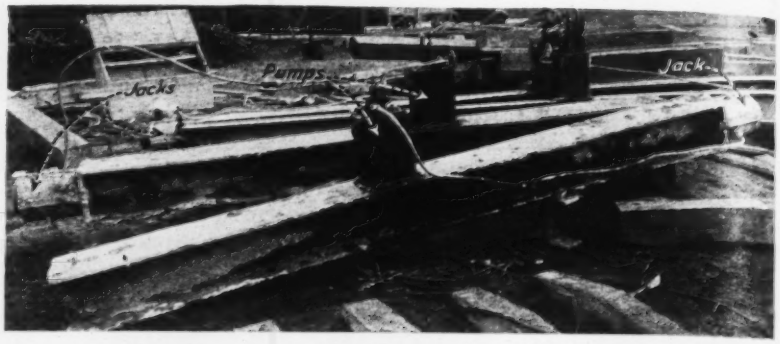
• • •

Brief Memoranda

The half-inch-thick shells of pipe piles used in constructing the West Side Express Highway in New York City are cut off with an oxy-acetylene torch. A perfectly square, smooth cut is made very quickly by using a brass collar to guide the tip of the torch. The collar has two hinges, one with a loose pin, so that it can be thrown around the pile and locked almost as quickly as a handcuff. It is then slid to the grademark set on the shell by level and clamped in place by means of a few turns of a set screw.—H. D. HAMMOND, *New York, N. Y.*

Feeding chloramine into a 12-mi. pipeline since 1934 has cleaned the pipe of algae and restored its carrying capacity to that of a new line. Continued dosing keeps the pipe clean. Previous to the chloramine treatment the line had been cleaned seven times in eleven years. The *C* in the Chezy formula dropped rapidly after each cleaning from about 140 to 105; a residual of from 0.2 to 0.3 p.p.m. is maintained.—J. WALTER ACKERMAN, *Chief Engineer and General Superintendent, Consolidated Water Co., Utica, N. Y.*

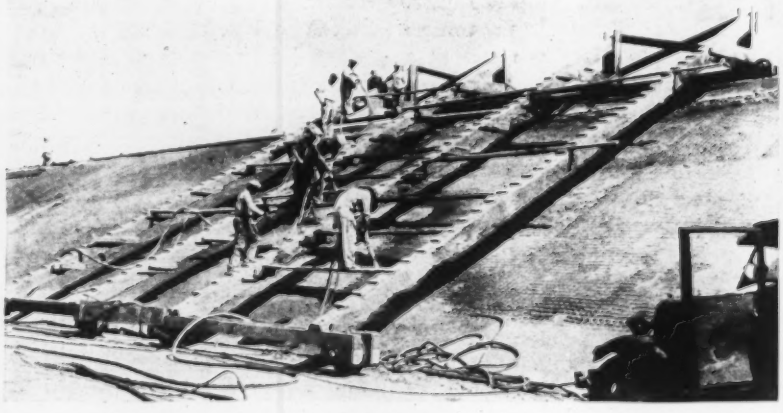
To escape condensation on the inside of the windows of the rapid sand filter building at Indianapolis, the steel sash are now being removed and replaced with glass blocks. Ventilation formerly furnished by the ventilating sash will be supplied by a large fan in the monitor of the building. The glass blocks fit the present brick openings and do not alter the exterior appearance of the building, except to improve it. The apppearance of the glass blocks from the inside of the building is better than that of the steel sash.—H. S. MORSE, *Manager, Indianapolis Water Co., Indianapolis, Ind.*



Jacking beams spread shaft sheeting for installing waling sets.

Shaft Wales Set by Jacks

In placing rectangular sets of steel H-beam waling to brace steel pile sheeting for a soft-ground shaft 23x35 1/3 ft. x 50 ft. deep, the field-made jacking beams illustrated were used to press the sheeting back so that the corner connections of the waling sets could be bolted. The 55-ft. pile sheeting was driven first and the waling sets were placed one after the other as the excavation deepened. The long side wales were placed first and the jacking beams were set between them, one at each end across the shaft, and extended to force back the sheeting so that the end wales could be chopped into place and bolted. The jacking beams as illustrated consist of a steel H-beam with a hydraulic jack welded to one end and a hand pump fastened to the beam flange at midpoint. Four jacking beams were used two at a time. The shafts were sunk to drive the Detroit River interceptor sewer tunnel at Detroit, Mich., now being constructed (*ENR* July 29, p. 138) by the S. A. Healy Co., contractors, and the jacking beam was devised by Harvey Kruse, superintendent.



Platform saves slopes from being trampled during paving operations

Carriage for Slopes

by G. LYLE STILLMAN

Department of Public Works, Rome, N. Y.

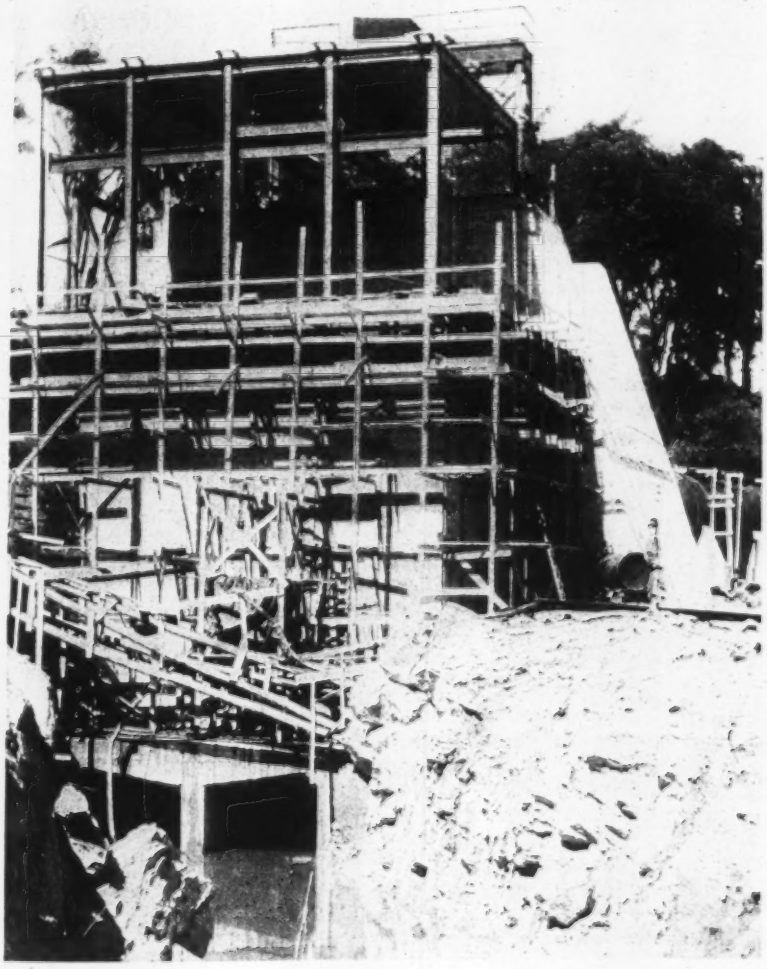
Soft sand slopes are being gunited untrampled, on the new 50-m.g. reservoir for the Rome, N. Y., water supply, by using the traveling platform illustrated. There are 104,000 sq. ft. of slope requiring paving 3 and 4 in. thick.

The embankment is of sand and gravel, which is easily disturbed when walked upon. To keep the men off the fine-graded slopes, it was decided to build two platforms, as shown, with 18 in. car wheels at the top and bottom of the embankment. Four 12 x 12-in. timbers 50 ft. long, are the main support of the platform. On the straightaway it moves very easily. The curves are somewhat more difficult to navigate.

John J. Gawkins is city engineer in charge of the construction. Emerson C. Roser is superintendent for the W.P.A., and John H. Ford is the superintendent for the Wertz Company, Cleveland, O., the contractors.

THE WEEK'S EVENTS

Continued from page 584



NEW HYDRO PLANT IN VERMONT

CLARKS FALLS hydro-electric plant now under construction by the Public Electric Light Co. on the Lamoille River in Vermont includes a concrete and earth-fill dam which will impound 4,600 acre-ft. of water. The concrete section of the dam, 400-ft. long, has a maximum height of 40 ft., while the 450-ft. earth section will be 20 ft. high. The dam has three tainter gates with a combined discharge capacity of 30,000 sec.-ft., four sections of stanchion splash board, and a free overflow spillway 100-ft. long. One of the tainter gates is to be operated by remote control from the Milton station a half mile below Clarks Falls.

Electric heaters and compressed air agitation will be provided to prevent freezing at the tainter gates, stanchion splash boards, and intakes; steam from an oil burner boiler will remove ice in an emergency. The discharge capacity of the dam is greater than the 1927 maximum of 85,000 sec.-ft.

There are no intake gates, but two Broome gates, motor driven with remote control, are provided in the forebay. A 4,000 hp. Kaplan-type turbine is direct-connected to a 3,000 kw. generator, operated by remote control from Milton.

Charles T. Main, Inc. of Boston is engineer on the project.

No Power Now At Fort Peck

Army Engineers report no present need for power installation at Fort Peck dam

That no immediate installation of power generation facilities should be made at Fort Peck dam due to absence of a market for power at the site, but that such a market may develop in the future and that when it does it will be advisable to provide for an ultimate capacity of 105,000 kw., is the conclusion of the army engineers, embodied in a report made by General Markham, chief of engineers, to the Senate committee on commerce.

The report points out that investigations made by the Federal Power Commission, with the findings of which the army engineers are in agreement, indicate that there is no reasonably assured market at present. The report states, however, that "development of irrigation projects may produce such a market" and recommends that power generation equipment be installed "at such time as in the judgment of the Secretary of War, the chief of the Corps of Engineers, or such power marketing agency as may be established by law," demand has developed. The size and number of units which should be installed "can best be determined as that market develops."

Big installation possible

The report finds that the most suitable installation would provide for an ultimate capacity of 105,000 kw. at an estimated cost of $6,750,000. This sum would be in addition to the $1,293,000 which has already been spent, providing a power penstock at the dam for use when power is developed.

It is recommended that the full capacity of the dam ultimately be developed by three generating units of 35,000 kw. each; two of these would be installed at first and the third added later. The initial 70,000 kw. installation would cost about $6,000,000, and adding of the third unit would bring the cost to $6,750,000.

The findings of the Federal Power Commission, to which General Markham's report referred, indicated that the development of a power market at Fort Peck depends upon the completion of projects for irrigating large areas on the Missouri River and its tributaries, the Milk and the Yellowstone. Of these potential markets, only one of the irrigation projects has been developed to date, and as to the others it is stated that "their futures are somewhat speculative."

PERSONAL

A. R. MacCleave has resigned as municipal engineer of Penticton, B. C.

Kaarlo W. Nasi has been appointed sanitary engineer of Richmond County, Wash., with headquarters at Colfax.

Capt. Herbert B. Loper, U. S. Engineers, who has been district engineer at Omaha since 1935, has been transferred to Fort Lawton, Wash.

Comdr. John N. Laycock of the Navy civil engineer corps has been detached from duty at the Navy Yard in Boston and has become public works officer at Portsmouth, N. H.

Capt. Peter O. Goers, U. S. Engineers, has been assigned as military assistant to the Memphis District Engineer. Captain Goers was formerly stationed at Fort Logan, Colo.

Cameron G. Will has been appointed Seattle's engineer in charge of construction at Ruby Dam. He was on the city's engineering staff until 1933, when he became engineer-examiner with PWA.

George W. Thompson is now with the U. S. Engineers as engineer at large on the Fort Peck project. For the past two years he was connected with the PWA in Montana on the Flint Creek irrigation project.

Clinton Adams, connected with the Birmingham division of the Alabama state highway department, has been put in charge of the testing material laboratory, succeeding J. N. Bradford, resigned.

Carrol B. Ireland, formerly city engineer of National City, Cal., but for the past six years engaged in other work, has been reappointed to his old position, succeeding Arnold Cayser, resigned.

Comdr. Paul J. Searles, Civil Engineer Corps, U. S. Navy, has been detached from duty at the Navy Yard in Pearl Harbor and assigned as public works officer in the Navy Yard at Boston and also as public works officer of the First Naval District.

Fred L. Johnson, a consulting engineer who was formerly city manager of Santa Barbara, Cal., has been appointed city manager of Coronado, Cal. He is a graduate of the engineering school of the University of California.

F. Sewell Wingfield has become chief project engineer of PWA power projects in Nebraska, succeeding A. R. Wellwood, who resigned recently. Mr. Wingfield has been assistant director of the PWA power division at Washington.

NEW HOMES BESIDE THE CHICAGO

THE MIDDLE WEST's largest PWA low-rent housing project is nearing completion. Julia P. Lathrop homes, $5,780,000 housing project in Chicago, is situated on a 38-acre tract on the north branch of the Chicago River. It contains 3,254 rooms in 925 living units. There are three-story apartments, two-story row houses, and two-story flats in the community.

The project is adjacent to the north side industrial center near the Loop. Hamlin Park, with a good playground, is a short distance away, and Lincoln Park and Lake Michigan are within a short bus ride.

John Lowe, III, has been appointed instructor in civil engineering at the college of engineering of the University of Maryland. Mr. Lowe graduated from the College of the City of New York in 1936 and has done graduate work at Massachusetts Institute of Technology.

Jasper L. Phillips resigned recently from his position as associate highway engineer for the Bureau of Public Roads to become district engineer with the North Carolina state highway commission. Mr. Phillips had been connected with the Bureau since 1935. Before that time he was for fourteen years chief of party on location work and resident engineer on construction work with the North Carolina highway commission.

A. J. Ackerman has resigned his position as head construction plant engineer of TVA and special assistant to C. A. Bock to return to private practice in the East. Mr. Ackerman has been associated with TVA since 1933 and has had charge of the design and selection of construction plant and equipment. Before his connection with TVA he was chief engineer for the contractor on Madden Dam in the Panama Canal Zone.

Eldon R. Dodge has been granted a leave of absence from his position as instructor in the department of civil engineering at the Case School of Applied Science and has been appointed as an instructor in the department of hydraulics and sanitary engineering at the University of Wisconsin. Mr. Dodge has been at Case since the fall of 1935; before that time he was mainly engaged in graduate study at the University of Wisconsin.

L. M. Bush, formerly city engineer of Oklahoma City, has opened offices in Oklahoma City to practice professional civil engineering, particularly in the fields of river control, pipelines, and city planning. Mr. Bush, a graduate of the School of Engineering of the University of Kansas, has done railroad valuation work for the Interstate Commerce Commission and was for eleven years a member of the firm C. D. Long & Co. of Oklahoma City and Nashville. He was city engineer of Oklahoma City for six years.

Comdr. James T. Mathews of the Navy Civil Engineer Corps has assumed the post of public works officer of the 11th Naval District at San Diego, Cal., succeeding Capt. George A. McKay who will retire Dec. 1. Comdr. Mathews has recently been with the Bureau of Yards and Docks in the Navy Department at Washington. He graduated from the U. S. Naval Academy in 1913, and after graduate study at Rensselaer Polytechnic Institute, he served as treaty engineer in Haiti. He has been attached to public works offices at the New York Navy Yard, the New London, Conn., submarine base, at Pearl Harbor and at Miami.

OBITUARY

JASON R. MEEK, 83, for 60 years county surveyor of Yuba County, Cal., died Sept. 16 at San Francisco.

RUBEN O. ADAMS, an excavating contractor of Buffalo, N. Y., died there Sept. 22 at the age of 73.

LLEWELLYN H. SALTER, 59, for many years head of the sanitary engineering department of Jefferson County, Ala., died in Birmingham on Sept 17.

FRANCIS M. HENRY, consulting engineer of Minneapolis and New York City, died in Minneapolis Sept. 24 at the age of 71.

GEORGE H. FREDERICK, 66-year-old contractor of St. Louis and formerly city building inspector there, died Sept. 21 at Pine Bluff, Ark.

ALBERT W. ATWATER, progress engineer for the TVA at Chickamauga Dam, died in New York City while on a vacation Sept. 24. Mr. Atwater was a graduate in 1909 of Purdue University.

ALFRED WILM, inventor of duralumin and a member of the faculty of the chemical engineering school at the University of Goettingen died Aug. 11 at Breslau, Germany.

FREDERICK C. FIELD, Philadelphia consulting engineer, died in that city Sept. 22 at the age of 62. Mr. Field graduated from the Massachusetts Institute of Technology in 1897. He retired from active practice ten years ago.

HAROLD ROLPH, president since 1917 of John S. Metcalf Co. Ltd., of Montreal, builders of grain elevators, died in Montreal Sept. 19 at the age of 66. A graduate of the University of Toronto, Mr. Rolph joined the Metcalf Co. in 1904 as inspecting engineer.

STUART S. OLIVER, 79, who retired in 1930 from the Quebec Railway, Light, Heat & Power Co. after 20 years' service, died recently in Quebec. Mr. Oliver was formerly a member of the engineering board of the Quebec & Lake St. John Ry. and the Canadian Northern Ry.

PETER CAMERON, Montreal structural engineer, died recently in that city. A graduate of the University of Chicago, Mr. Cameron was first associated with the firm of John S. Metcalf of Montreal and later with the firms of George A. Fuller Construction Co. and Cook & Leitch.

ELBRIDGE R. CONANT, civil engineer and first city manager of Savannah, Ga., died in Boston Sept. 24 at the age of 72. A graduate in 1889 of the Massachusetts Institute of Technology, Mr. Conant was engaged for 21 years in river and harbor improvement work in Georgia and Florida. He was a past president of the American Society for Municipal Improvement.

WARREN R. THOMPSON, a construction engineer associated since 1923 with the Cities Service Co., died in New York City Sept. 26 at the age of 60. Mr. Thompson graduated in 1897 from Pennsylvania College, and after 12 years with various engineering companies, he became manager of J. M. Byllesby & Co., remaining with that organization until 1923 except for two years' service during the war.

• • •

Yardage Records Set At Fort Peck

A season record was set at the Fort Peck Dam project when 2,476,000 cu.yd. of hydraulic fill were placed in the dam during the first half of September, the largest yardage for any half-month period during the season. This placement brings the total amount of hydraulic fill in the dam to 73,050,000 cu.yd. and the total placement during the present year to about 20,000,000 cu.yd.

During the fourteen days ending September 23, 200,000 cu.yd. or more were pumped into the dam every day, setting a project record. The previous record was set this year with a run of twelve 200,000-yd. days, while last year there was a run of 11 days.

• • •

New Faculty Appointments At Cooper Union

Eleven new appointments have been made to the faculty of the engineering school of Cooper Union, New York City. Two of these are in the civil engineering department.

Benjamin Levine will teach algebra and analytic geometry in the night school. Mr. Levine was for six years a construction engineer in the Soviet Union and was one of the designers of the Moscow subway system. He graduated from Cooper Union Institute of Technology in 1921.

Paul H. Robbins, who was appointed to the civil engineering staff, has been working as a structural draftsman for the Pittsburgh Bridge & Iron Works. He holds engineering degrees from Syracuse University and Massachusetts Institute of Technology.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual meeting, Scranton, Pa., Oct. 11-13.

NATIONAL SAFETY CONGRESS, Kansas City, Oct. 11-15.

NATIONAL RECLAMATION ASSOCIATION, annual meeting, Casper, Wyo., Oct. 12-14.

AMERICAN MUNICIPAL ASSOCIATION, annual meeting, Chicago, Oct. 13-15.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, annual convention, Elmira, N. Y., Oct. 15-16.

AMERICAN WELDING SOCIETY, annual meeting and exposition, Atlantic City, N. J., Oct. 18-22.

OHIO CONFERENCE ON SEWAGE TREATMENT, Cincinnati, Ohio, Oct. 19-20.

CANADIAN INSTITUTE OF SEWAGE AND SANITATION, annual convention, London, Ont., Oct. 21-22.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, White Sulphur Springs, W. Va., Oct. 27-29.

HIGHWAY RESEARCH BOARD, annual meeting, Washington, D. C., Dec. 1-3.

THE ASPHALT INSTITUTE, national asphalt conference, Memphis, Dec. 6-13.

ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, annual meeting, Memphis, Dec. 6-11.

UNIVERSITY OF KENTUCKY, road and street school, Lexington, Ky., Dec. 6-9.

REGIONAL AND LOCAL

SECTION MEETINGS, AMERICAN WATER WORKS ASSOCIATION: New Jersey, Atlantic City, Oct. 15-16; Southwest, Austin, Tex., Oct. 18-21; California, Sacramento, Oct. 20-23; Virginia, Richmond, Nov. 4-6; Missouri Valley, Omaha, Nebr., Nov. 4-6; Wisconsin, Green Bay, Nov. 8-10.

SOUTH DAKOTA WATER AND SEWAGE WORKS CONFERENCE, annual meeting, Sioux Falls, S. D., Oct. 11-12.

TEXAS PUBLIC HEALTH ASSOCIATION, annual meeting, Dallas, Nov. 1-3.

• • •

License Examinations

NEW YORK: Examinations for professional engineering Jan. 24-26, and for land surveying Jan. 27, at Albany, Buffalo, New York and Syracuse. Applications must be filed Nov. 1.

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

LOWER LUMBER PRICES are the principal change this month. Southern pine prices are down 50c. to $2.00 in Atlanta; pine, spruce and fir are $1.00 to $5.00 lower in Boston; one- and three-inch short leaf pine is down $1.50 to $3.00 in Chicago, while two-inch is up $1.00 to $8.00. 2 x 10 Douglas fir is up $5.00, but heavy fir timbers are off $3.00. Pine is down $2.00 to $6.00 in Cleveland, $1.00 in St. Louis, and $1.00 to $2.00 in Kansas City. Fir is $1.00 to $2.00 off in New York, but up $1.00 to $3.00 in Baltimore. The Seattle base price on plywood is $4.25 lower on the 5/8-in. and $4.85 lower on 3/4-in.

All aggregate prices are up 80c. and ready-mixed concrete, 77c. in Los Angeles. Gravel is up 40c. and sand, 30c. per ton in New York.

Steel shapes and bars prices are up 10c. per cwt., and metal lath, $2.00 per 100 sq.yd. in Baltimore. Sheet piling prices increase 5c. per cwt. in Baltimore, 35c. in San Francisco, but decrease 27c. in St. Louis. Skilled labor rates are 12 1/2c. to 25c. higher on all types in Kansas City. Common labor is 5c. higher in both Baltimore and Kansas City.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT			SAND AND GRAVEL			CRUSHED STONE		CRUSHED SLAG		CONCRETE
	Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included			Per ton, carload lots			Per ton, carload lots		Per ton, carload lots, f.o.b. plant		Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.83	$2.58	$2.50	$1.65	$1.65	$1.55	$1.65	$1.75	$1.65	$1.75	$8.90
Baltimore	2.31	2.06	1.86	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.80‡	1.80‡	7.35
Birmingham	2.40	2.15	1.95	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.25*b*	2.00*b*	1.80*b*	1.20	1.20	.80	1.20	1.20	....	....	7.00*m*
Chicago	2.45	2.20	2.05	1.00‡	1.00‡	1.00‡	1.35‡	1.35‡	1.00‡	1.00‡	....
Cincinnati	2.53	2.28	2.08	1.20	1.20	1.30	1.80	1.80	....	....	6.60
Cleveland	2.45	2.20	....	1.40	1.40	1.30	1.60	1.60	1.65	1.65	7.40*i*
Dallas	2.30	2.05	1.85	1.40	1.40	1.05	1.00	1.15	1.84	1.89	7.00
Denver	3.08	2.85	....	1.20	1.40	.90	....	....	....	....	....
Detroit	2.20	1.95	1.80	1.15	1.25	.95	1.50	1.60	1.15‡	1.25‡	6.25
Kansas City	2.55	2.30	2.06	1.85	2.30	1.15	1.85	1.80	....	....	7.90*m*
Los Angeles	2.32	2.12	....	2.00	2.00	1.70	2.00*f*	2.00*f*	....	....	7.60
Minneapolis	2.86	....	2.41	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.15*j*
Montreal	....	....	1.70*c*	.80	.85	1.15‡	1.20‡	1.30‡	....	....	6.50*l*
New Orleans	2.37	2.12	....	1.50	1.50	1.25	....	....	....	....	8.00
New York	2.50‡	2.20‡	....	1.50*de*	1.50*de*	1.00*de*	1.65*de*	1.75*de*	....	....	7.70
Philadelphia	2.55	2.30	2.10	1.55‡	1.65‡	1.25‡	2.00‡	2.05‡	1.00	1.00	8.25*k*
Pittsburgh	2.40	2.15	1.95	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.52	2.27	....	1.50‡	1.50‡	1.50‡	.85*h*	.85*h*	.65/.95*g*	.50/.85*g*	7.50
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	....	....	7.50
Seattle	3.10	2.85	....	1.17*o*	1.17*o*	1.17*o*	1.33*o*	1.33*o*	....	....	7.30*o*

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Sales tax included. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more *o* 2% off for cash.

CASH DISCOUNTS, CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice, in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Northampton, Pa.	$1.65	$1.60
Crestmore, Calif.	1.72	....	Iola, Kans.	1.70	1.65	North Birmingham, Ala.	1.75	1.70
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	La Salle, Ill.	1.70	1.65	Richard City, Tenn.	1.85	1.80
Hannibal, Mo.	1.70	1.65	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hudson, N. Y.	1.75	1.70	Mason City, Ia.	1.70	1.65	Universal, Pa.	1.65	1.60
Independence, Kans.	1.70	1.65	Norfolk, Va.	1.70	1.65	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70

LOWER PENINSULA, MICHIGAN. Uniform carload lot cement price established March, 1937.

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OILS	ASPHALT EMULSION	
	Granite per M, lots of 50,000, 4x4x8 in.	Brick per M, 3x4x8½ in., carload lots	Wood per sq. yd., 3½ in. 16-lb. treat	Per ton, less than 80 penetration, Tank car	Drums	Per gal., 80–300 penetration, Tank car	Drums	Per ton, Tank car	Drums	Per gal., Drums	Per gal., Tank car	Drums
Atlanta	$75.00	‡38.85	$2.25	$18.20*e*	$23.41*e*	$0.0728*e*	$0.1049*e*	$.0768*he*	$.1089*he*	$0.0668*e*	$0.0834	$0.0834
Baltimore	135.00	44.00‡	2.50	17.00	22.00	.075	.10	.09*h*	.125*h*	.....	.....	.....
Birmingham	.....	25.00	.....	19.00	24.00	.0878	.1128	.102*h*	.137*h*	.....	.....	.....
Boston	75.00	46.50	3.00	17.00‡	22.00‡	.07‡	.095‡	.09*h*‡	.12*h*‡	.075‡	.095‡	.125‡
Chicago	140.00	48.00	2.50	18.00	23.00	17.00*g*	22.00*g*	.07*h*	.11*h*	.05	.09	.135
Cincinnati	112.00	37.50	.....	13.47	17.47	.12*d*	.....	17.00	.....	.051	.078	.....
Cleveland	3.75*a*‡	37.50	2.85	18.00	21.75	.081	.099	.09*1h*	.061*h*	.06	.095	.099
Dallas	.....	32.50	.....	15.80	20.00	.05	.08	14.80	23.00	.05	.075	.105
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	16.72*f*	21.97*f*	.....	20.60*g*	15.60	20.60	.0535	.1125	.1525
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	11.00	15.16	11.00*g*	15.16*g*	11.00	.....	.042	.06	.12
Minneapolis	.....	.....	1.90*d*	21.70	26.70	.098	.137	21.85	34.65	.0638	.....	.....
Montreal	85.00*c*	60.00	3.42	14.00	20.00	.10	.13	.0975*h*	.01125*h*	.0675	.135	.165
New Orleans	.....	.....	.....	14.00	17.00	.065	.09	.07*h*	.10*h*	.....	.078	....
New York	.....	67.00	2.85	17.00	22.00	.075	.10	.09*h*	.125*h*	.....	.075	.11
Philadelphia	120.00	.....	.....	15.00	20.00	.06	.085	.065*h*	.095*h*	.055	.07	.10
Pittsburgh	115.00	40.00	.....	19.00	24.00	.077	.1125	.068*h*	.121*h*	.0675	.....	.....
St. Louis	115/130	37.00	.....	19.00	24.00	.075	.11	.08*h*	.115*h*	.0475	.09	.12
San Francisco	.....	70.00	.....	12.00	18.00	12.00*g*	18.00*g*	12.50	23.00	.04	.0575	.117
Seattle	.....	60.00*i*	.....	25.55	25.55	19.50*g*	25.55*g*	15.50/16.50	28.50	8.15*g*	.075	.1325

‡ Delivered. *a* 4½x6x5½ in. per sq. yd. delivered. *b* 4x5x9 in. aver. *c* Sales tax included. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* 3½x4x8½ in.

(Continued on second following page)

HE
McGRAW
Engineering
Library